27179

DATE REPORT ACCEPTED
DISPOSITION
SAM SIGNATURE

PRELIMINARY ASSESSMENT

U.S. Plating Burn Site
Atlanta, Fulton County, Georgia

CERCLIS ID No.: GAD984282301

September 30, 1993

DATE REPORT ACCEPTED 1-16-94
DISPOSITION NFRAP
SAM SIGNATURE

State of Georgia
Department of Natural Resources
Environmental Protection Division
Hazardous Waste Management Branch

Prepared By:

Kenneth Grall
Environmental Engineer

Reviewed By:

Susan Eason
Acting Unit Coordinator

Approved By:

Bill Mundy
Program Manager

1.0 INTRODUCTION

Under authority of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Georgia Environmental Protection Division, Hazardous Waste Management Branch conducted a Preliminary Assessment (PA) at the U.S. Plating Burn site in Atlanta, Fulton County, Georgia. The purpose of this investigation was to collect information concerning conditions at the U.S. Plating Burn site sufficient to assess the threat posed to human health and the environment and to determine the need for additional CERCLA/SARA or other action. The scope of the investigation included review of available file information, a comprehensive target survey, an off-site reconnaissance, and an on-site survey.

2.0 SITE DESCRIPTION, OPERATIONAL HISTORY, AND WASTE CHARACTERISTICS

2.1 Location

United States Plating & Bumper Service, Inc. (U.S. Plating) is located in Atlanta, Fulton County, Georgia. The street address is 78 Milton Avenue SE, Atlanta, Georgia 30315 with geographic coordinates of 33°43′47" N latitude and 84°23′12" W longitude (Figures 1, 2; Refs. 1, 2). Jeanette C. Gage is the president of U.S. Plating and can be reached at (404)627-5703 (Refs. 1, 3).

The climate in Fulton County is humid and continental with mild winters and variable temperatures. The average temperatures for the months of January and July are 45°F and 80°F respectively. Peak rainfall occurs in the winter and midsummer (Ref. 4). The average annual rainfall for the area is 49 inches (Refs. 4, 5) and the 2-year, 24-hour storm rainfall is 4 inches (Ref. 6). The mean annual lake evaporation is 41 inches and the prevailing winds come from the northwest and go to the southeast (Ref. 5). (Ref. 7).

2.2 Site Description, Operational History, and Waste Characteristics

On July 31, 1992 in Atlanta, Fulton County, Georgia a fire occurred at United States Plating & Bumper Service, Inc. This company was an industrial and commercial electroplating operation specializing in straightening, polishing, and chrome-plating motorcycle parts, automobile bumpers, antique car parts, and other industrial and commercial plating. The business began in 1960 and at the time of the fire a total of ten (10) people were employed at the 20,000 sq. ft. one-story building. The list of constituents that were involved in the operations at U.S. Plating were Barium, Chromium, Nickel, HCl, Acid Salts, Caustic Cleaner, Sulfuric Acid mixed with water, and Hydrogen Peroxide. Approximately 2,000 gpm of fire water was used from the night of July 30 till the morning of July 31 to fight the fire. (Refs. 1, 3, 8; Figures 1, 2).

U.S. Plating's contractor, Conversion Technology, Inc., collected and analyzed nine ash samples to determine the hazardous nature of the waste. TCLP for metals and pH were ran on all the samples and none of the results indicated a hazardous waste (Ref. 9; Figure 3).

EPD TAT collected and ESD analyzed four grab soil samples and three composite ash samples. The on-site ash composite samples (collected at depths of 0-3", made up of 3 aliquots taken at random locations) and soil grab samples (collected at depths of 1 foot and 2 feet) were analyzed for total metals, TCLP metals, and pH (Refs. 8, 10, 11, 12, 13, 14; Figures 4, 5).

The sampling results indicated the front pile of ash (from sampling location USP1A) was not a hazardous waste, though the rear ash pile was characteristically hazardous. The maximum contaminant concentrations that were detected in the ash composite surface samples were 2,060 ppm total chromium and 15,400 ppm total nickel. A pH of 0.35 and TCLP chromium leachate of 68.5 mg/l was recorded (Refs. 11, 13).

The soil sampling results showed a range of 71.5-1,200 mg/kg total chromium and 604-1,380 mg/kg total nickel (Ref. 11). Due to the acidic conditions detected on-site, the mobility of the metals in the soil may increase and cause the metals to migrate vertically downward into the groundwater.

During the site reconnaissance on August 16, 1993, four leaking 55-gallon drums were found on-site (Photos 1, 2; Figure 2). The leakage was tested by pH paper and showed a pH of 13 (Photo 2). The leakage was dripping down into a concrete drain that led to a floor sump (Photos 2, 3, 4; Figure 2). All of the leakage was being absorbed by the dirt in the bottom of the drain (Photos 1, 2, 3).

One 55-gallon stainless steel drum was also present on-site (Photo 5; Figure 2). This drum has Ashland Chemical Co. imprinted into the lid of the drum and its contents have a pH of 0.0 by pH paper (Photo 5).

There are five plating vats located in the center of the burned building that are filled with scrap metal and burned debris (Photos 6, 7; Figure 2). Rain water has drained through one of the vats and is dripping onto the concrete floor. The pH of the leachate is 10 by pH paper (Photo 8). The approximate vat size is 6'x4'x5'.

The ash piles from the fire have been placed in the plating vats and/or removed from the site. Scrap steel has been stockpiled on-site and some steel scrap has been removed by Mendis Recycling (Ref. 8; Photos 6, 7, 9, 10, 11, 12, 13).

3.0 GROUNDWATER PATHWAY

3.1 Hydrogeologic Setting (Ref. 7)

U.S. Plating is located in the Piedmont physiographic province (Ref. 15). The topography of the area consists of low, well-rounded hills and long, rolling, northeast-trending ridges with an average elevation of 950 feet above mean sea level (Ref. 15).

The land surface in the Piedmont is underlain by a clay-rich, residual material called saprolite, derived from the in-place chemical weathering of the bedrock. This soil material averages about 30 to 60 feet in thickness (Ref. 15). In many valleys, the saprolite has been removed through erosion, and the bedrock is exposed or only thinly covered by fluvial deposits. Soil is present nearly everywhere as a layer of variable thickness on top of the residual soil (Ref. 15). The underlying bedrock is composed mainly of metasedimentary and metavolcanic rocks, regionally metamorphosed and deformed into northeast-trending folds. These fractured rocks, combined with the overlying soil material, make up the crystalline rock aquifer system, which is confined. The fractured crystalline rocks and overlying saprolite and alluvium are hydraulically interconnected. Saturation in the crystalline rock aquifer rarely exceeds 300 feet below land surface (bls) (Refs.16, 17, 18). The approximate range of hydraulic conductivity for clayey soils and fractured rocks of the Piedmont physiographic province is from 10^{-3} to 10^{-5} cm/sec (Ref. 19).

The bedrock underlying the facility is composed of the Big Cotton Indian Formation of the Atlanta Group. The Big Cotton Indian Formation consists of late Precambrian to early Paleozoic, metamorphosed, intrusive rocks. The formation includes intercalated biotite-plagioclase gneiss, hornblende-plagioclase amphibolite, and biotite-muscovite shist (Refs. 15, 17).

Groundwater in the crystalline rock aquifer system occupies joints, fractures, and other secondary openings in bedrock and pore spaces in the overlying residual soil material. Water recharges the underground openings by seeping through this material or by flowing directly into openings in exposed rock. This recharge is from precipitation that falls in the area (Ref. 16). The water table in the Piedmont approximately conforms with the surface topography (Ref. 20).

The quality of groundwater available varies greatly with the location, rock type, topographic setting, and geologic structure. Localized increases in permeability may enhance well yields. This occurs mainly in association with certain structural and stratigraphic features, including contact zones between rock units of contrasting character, contact zones within multilayered units, fault zones, stress relief fractures, zones of fracture concentration, and shear zones (Ref. 16).

3.2 Groundwater Targets (Ref. 7)

In the greater Atlanta region, groundwater is an undeveloped resource, and all public drinking water supplies are obtained from developed surface water resources. Within a 4-mile radius of the site, there are no reported public or private users that rely on area aquifers for potable water supplies. Drinking water is obtained from the Atlanta Municipal Water System which uses a surface water intake on the Chattahoochee River (Refs. 21, 22, 23, 24).

3.3 Groundwater Conclusions

A release to groundwater is suspected. Nickel and chromium contamination has been detected in the soils and due to the acidic conditions on-site, the mobility of the metals is suspected to have increased. With increased metal mobility, rain water infiltration could wash contaminants down into the groundwater.

4.0 SURFACE WATER PATHWAY

4.1 Hydrologic Setting

The surface water runoff is not well defined. Overland flow appears to be directed to the northwest and then changes direction to the southwest (Photos 14, 15; Figure 2). The runoff enters a storm drain approximately 80 feet southwest of the burn site. An equalization basin is up gradient from the storm drain (Photo 15). It is not apparent where the inflow into the basin comes from. The basin discharges to the storm sewer.

4.2 Surface Water Targets

The surface water runoff enters a storm drain on-site that is part of the city of Atlanta's sewer system. Once the runoff enters the sewer system it would be impossible to segregate U.S. Plating's runoff water from other waters in the system. Drinking water is obtained from the Atlanta Municipal Water System. The city of Atlanta obtains its water from a surface water intake located on the Chattahoochee River on Ridgewood Road off of Moore's Mill Road at the confluence of the Chattahooche River and Nancy Creek (Refs. 21, 22, 23, 24).

4.3 Surface Water Conclusions

During the night of July 30 till the morning of July 31, 1992 water was pumped at a rate of 2,000 gpm onto the fire. The fire water runoff drained down into the storm drain on-site (Figure 2; Ref. 3). Currently, no waste runoff from the site is occurring. When it rains water will drain to the on-site storm drain. A release to the storm drain occurred during the fire. No current release is suspected.

5.0 SOIL EXPOSURE AND AIR PATHWAYS

5.1 Physical Conditions

U.S. Plating is in an industrial/residential area. The site is inactive though the neighboring facilities have access to the burn site. The entire three facilities are surrounded by a fence.

5.2 Soil and Air Targets

Workers at the two neighboring facilities have access to the burn site. The nearest school is 1/4 mile away and the population within a 0.25 mile is 610. The 4-mile radius population is 169,783 (Ref. 25). Wetlands that exist within the 4-mile radius of the site consist of small lakes and creeks (Ref. 26). No federally endangered/threatened species live within the 4-mile radius (Refs. 27). The facility lies outside of the 500 year flood plain (Ref. 28).

5.3 Soil Exposure and Air Pathway Conclusions

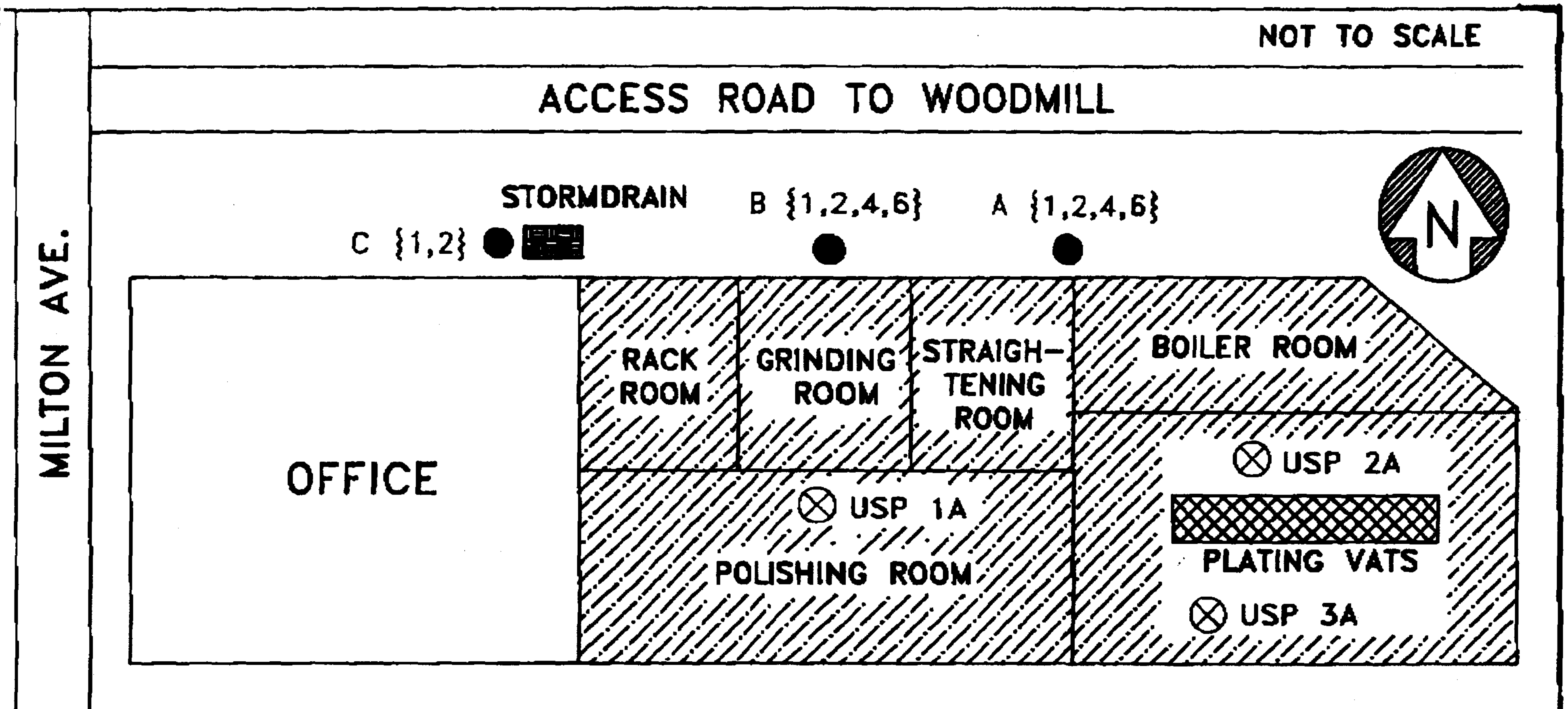
A release to the soil has been documented. Elevated nickel and chromium levels have been reported (Refs. 11). No release to the air is suspected.

6.0 SUMMARY AND CONCLUSIONS

On July 31, 1992 a fire occurred at U.S. Plating and the entire back portion of the facility was consumed. After the fire, ash and soil samples were collected. The ash sampling results indicated part of the ash was hazardous (Refs. 11, 12, 13, 14) and that the soil showed presence of contamination (Ref. 11). During the site reconnaissance on August 16, 1993 for the PA, five 55-gallon drums containing hazardous waste were present at the site (Photos 1, 2, 5; Figure 2). The Georgia Environmental Protection Division proceeded to take enforcement action against U.S. Plating by notifying them of their miss management of hazardous wastes in containers (Ref. 29). On Septemeber 21, 1993 a follow up inspection was performed to insure US Plating had disposed of the containers. The drums were removed from the site. Five plating vats continue to hold ash, burned debris, and scrap metal. It is suggested that a TCLP analysis be performed on the ash before it is disposed of.

A release has occurred to the soils and a release is suspected to have occurred to the groundwater. No release is suspected to have occurred to the surface water and air. The on-site runoff flows to a storm drain and then flows through the city of Atlanta's sewer system.

r:\user\kenneth\mydocs\usplatin.pa



U.S. PLATING SITE

ATLANTA, FULTON COUNTY, GEORGIA

TDD# 04-9208-0005

SITE DIAGRAM/SAMPLING LOCATION MAP

LEGEND

● SOIL SAMPLE (GRAB) [C-1,C-2;A-1,A-2: SPLITS WITH PRP]

⊗ ASH SAMPLE COMPOSITE

▨ BURNED AREA

OVERSIZED

DOCUMENT

APPENDIX A

OMB Approval Number: 2050-0095
Approved for Use Through: 1/92

PA Scoresheets

Site Name: U.S Plating Burn Site

CERCLIS ID No.: GAD984282301

Street Address: 78 Milton Avenue, SE

City/State/Zip: Atlanta, GA 30315

Investigator: Ken Grall

Agency/Organization: GADNR/EPD/Hazardous Waste Bran

Street Address: Floyd Tower East, Suite 1154
205 Butler St., S.E.

City/State/Zip: Atlanta, GA 30334

Date: 09/30/93

EPA

Potential Hazardous Waste Site Preliminary Assessment Form

Identification

State: GA
CERCLIS Number: GAD984282301
CERCLIS Discovery Date: 09/01/92

1. General Site Information

Name: United States Plating & Bumper Service, Inc.	Street Address: 78 Milton Avenue, SE				
City: Atlanta	State: GA	Zip Code: 30315	County: Fulton	Co. Code: 121	Cong. Dist: 05
Latitude: 33° 43' 47.0" Longitude: 84° 23' 12.0"	Approximate Area of Site: ____ Acres; 20,000 Square Ft		Status of Site: ☐ Active ☒ Inactive ☐ Not Specified ☐ NA (GW plume, etc.) Remodeling		

2. Owner/Operator Information

Owner: Jeanette C Gage			Operator: Same as owner		
Street Address: 78 Milton Avenue, SE			Street Address:		
City: Atlanta			City:		
State: GA	Zip Code: 30315	Telephone: (404) 627-5703	State:	Zip Code:	Telephone: ( )

Type of Ownership:
- ☒ Private
- ☐ Federal Agency Name______
- ☐ State
- ☐ Indian
- ☐ County
- ☐ Municipal
- ☐ Not Specified
- ☐ Other______

How Initially Identified:
- ☐ Citizen Complaint
- ☐ PA Petition
- ☐ State/Local Program
- ☐ RCRA/CERCLA Notification
- ☐ Federal Program
- ☒ Incidental
- ☐ Not Specified
- ☐ Other______

3. Site Evaluator Information

Name of Evaluator: Ken Grall	Agency/Organization: GADNR / EPD / Hazardous Waste	Date Prepared:	
Street Address: Floyd Tower East, Suite 1154; 205 Butler St, S.E.		City: Atlanta	State: GA
Name of EPA or State Agency Contact: Bill Mundy		Street Address: Floyd Tower East, Suite 1154 205 Butler Street, S.E.	
City: Atlanta		State: GA	Telephone: (404) 656-7802

4. Site Disposition (for EPA use only)

Emergency Response/Removal Assessment Recommendation: ☐ Yes ☐ No Date: ______	CERCLIS Recommendation: ☐ Higher Priority SI ☐ Lower Priority SI ☐ NFRAP ☐ RCRA ☐ Other______ Date: ______	Signature: Name (typed): Position:

CERCLIS Number: GAD 984282301

5. General Site Characteristics

Predominant Land Uses Within 1 Mile of Site (check all that apply):

- ☒ Industrial
- ☒ Commercial
- ☒ Residential
- ☐ Forest/Fields
- ☐ Agriculture
- ☐ Mining
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility ____________
- ☐ Other ____________

Site Setting:

- ☐ Urban
- ☒ Suburban
- ☐ Rural

Years of Operation:

Beginning Year 1960

Ending Year still operating
Remodeling due to fire

☐ Unknown

Type of Site Operations (check all that apply):

- ☒ Manufacturing (must check subcategory)
  - ☐ Lumber and Wood Products
  - ☐ Inorganic Chemicals
  - ☐ Plastic and/or Rubber Products
  - ☐ Paints, Varnishes
  - ☐ Industrial Organic Chemicals
  - ☐ Agricultural Chemicals (e.g., pesticides, fertilizers)
  - ☐ Miscellaneous Chemical Products (e.g., adhesives, explosives, ink)
  - ☐ Primary Metals
  - ☒ Metal Coating, Plating, Engraving
  - ☐ Metal Forging, Stamping
  - ☐ Fabricated Structural Metal Products
  - ☐ Electronic Equipment
  - ☐ Other Manufacturing
- ☐ Mining
  - ☐ Metals
  - ☐ Coal
  - ☐ Oil and Gas
  - ☐ Non-metallic Minerals
- ☐ Retail
- ☐ Recycling
- ☐ Junk/Salvage Yard
- ☐ Municipal Landfill
- ☐ Other Landfill
- ☐ DOD
- ☐ DOE
- ☐ DOI
- ☐ Other Federal Facility ____________
- ☐ RCRA
  - ☐ Treatment, Storage, or Disposal
  - ☐ Large Quantity Generator
  - ☐ Small Quantity Generator
  - ☐ Subtitle D
    - ☐ Municipal
    - ☐ Industrial
  - ☐ "Converter"
  - ☐ "Protective Filer"
  - ☐ "Non- or Late Filer"
- ☐ Not Specified
- ☐ Other ____________

Waste Generated:

- ☒ Onsite
- ☐ Offsite
- ☐ Onsite and Offsite

Waste Deposition Authorized By:

- ☐ Present Owner
- ☐ Former Owner
- ☐ Present & Former Owner
- ☒ Unauthorized
- ☐ Unknown

Waste Accessible to the Public:

- ☒ Yes
- ☐ No

Distance to Nearest Dwelling, School, or Workplace:

100 Feet

6. Waste Characteristics Information

Source Type: (check all that apply)	Source Waste Quantity: (include units)	Tier*:
☐ Landfill		
☐ Surface Impoundment		
☒ Drums ~ 5	250 gallons	V
☒ Tanks and Non-Drum Containers	4400 gallons	V
☐ Chemical Waste Pile		
☐ Scrap Metal or Junk Pile		
☐ Tailings Pile		
☐ Trash Pile (open dump)		
☐ Land Treatment		
☐ Contaminated Ground Water Plume (unidentified source)		
☐ Contaminated Surface Water/Sediment (unidentified source)		
☒ Contaminated Soil	2000 ft.^{2}	A
☐ Other ____________		
☐ No Sources		

* C = Constituent, W = Wastestream, V = Volume, A = Area

General Types of Waste (check all that apply)

- ☒ Metals
- ☐ Organics
- ☐ Inorganics
- ☐ Solvents
- ☐ Paints/Pigments
- ☐ Laboratory/Hospital Waste
- ☐ Radioactive Waste
- ☐ Construction/Demolition Waste
- ☐ Pesticides/Herbicides
- ☒ Acids/Bases
- ☐ Oily Waste
- ☐ Municipal Waste
- ☐ Mining Waste
- ☐ Explosives
- ☒ Other Burned Debris

Physical State of Waste as Deposited (check all that apply):

- ☒ Solid
- ☐ Sludge
- ☐ Powder
- ☒ Liquid
- ☐ Gas

CERCLIS Number: GAD 984282301

7. Ground Water Pathway

Is Ground Water Used for Drinking Water Within 4 Miles:
☐ Yes
☒ No

Type of Drinking Water Wells Within 4 Miles (check all that apply):
☐ Municipal
☐ Private
☐ None

Is There a Suspected Release to Ground Water:
☒ Yes
☐ No

Have Primary Target Drinking Water Wells Been Identified:
☐ Yes
☒ No
If Yes, Enter Primary Target Population:
______ People

List Secondary Target Population Served by Ground Water Withdrawn From: N/A

0 - ¼ Mile	______
> ¼ - ½ Mile	______
> ½ - 1 Mile	______
> 1 - 2 Miles	______
> 2 - 3 Miles	______
> 3 - 4 Miles	______
Total Within 4 Miles	______

Depth to Shallowest Aquifer:
20 Feet

Karst Terrain/Aquifer Present:
☐ Yes
☒ No

Nearest Designated Wellhead Protection Area:
☐ Underlies Site
☐ >0 - 4 Miles
☒ None Within 4 Miles

8. Surface Water Pathway

Type of Surface Water Draining Site and 15 Miles Downstream (check all that apply):
☐ Stream ☐ River ☐ Pond ☐ Lake
☐ Bay ☐ Ocean ☒ Other The surface water drains into a storm sewer.

Shortest Overland Distance From Any Source to ~~Surface Water~~: Storm Drain
80 Feet
— Miles

Is There a Suspected Release to Surface Water:
☐ Yes
☒ No

Site is Located in:
☐ Annual - 10 yr Floodplain
☐ > 10 yr - 100 yr Floodplain
☐ > 100 yr - 500 yr Floodplain
☒ > 500 yr Floodplain

Drinking Water Intakes Located Along the Surface Water Migration Path:
☐ Yes
☒ No

Have Primary Target Drinking Water Intakes Been Identified:
☐ Yes
☒ No

If Yes, Enter Population Served by Primary Target Intakes:
______ People

List All Secondary Target Drinking Water Intakes: N/A - None

Name	Water Body	Flow (cfs)	Population Served
		Total within 15 Miles	

Fisheries Located Along the Surface Water Migration Path:
☐ Yes
☒ No

Have Primary Target Fisheries Been Identified:
☐ Yes
☒ No

List All Secondary Target Fisheries: N/A

Water Body/Fishery Name	Flow (cfs)

EPA

CERCLIS Number: GAD 984282301

8. Surface Water Pathway (continued)

Wetlands Located Along the Surface Water Migration Path:
☐ Yes
☒ No

Have Primary Target Wetlands Been Identified:
☐ Yes
☒ No

List Secondary Target Wetlands: N/A

Water Body	Flow (cfs)	Frontage Miles

Other Sensitive Environments Located Along the Surface Water Migration Path:
☐ Yes
☒ No

Have Primary Target Sensitive Environments Been Identified:
☐ Yes
☒ No

List Secondary Target Sensitive Environments: N/A

Water Body	Flow (cfs)	Sensitive Environment Type

9. Soil Exposure Pathway

Are People Occupying Residences or Attending School or Daycare on or Within 200 Feet of Areas of Known or Suspected Contamination:
☐ Yes
☒ No

If Yes, Enter Total Resident Population:
________ People

Number of ~~Workers Onsite~~ Neighboring Workers:
☐ None
☒ 1 - 100
☐ 101 - 1,000
☐ >1,000

The neighboring facilities have access to the site. No workers are present at the US Plating Burn Site.

Have Terrestrial Sensitive Environments Been Identified on or Within 200 Feet of Areas of Known or Suspected Contamination:
☐ Yes
☒ No

If Yes, List Each Terrestrial Sensitive Environment:

10. Air Pathway

Is There a Suspected Release to Air:
☐ Yes
☒ No

Enter Total Population on or Within:

Nearby Workers Onsite	50
0 - ¼ Mile	611
> ¼ - ½ Mile	2020
> ½ - 1 Mile	8473
> 1 - 2 Miles	35,570
> 2 - 3 Miles	49,372
> 3 - 4 Miles	73,687
Total Within 4 Miles	169,783

Wetlands Located Within 4 Miles of the Site:
☒ Yes
☐ No

Other Sensitive Environments Located Within 4 Miles of the Site:
☐ Yes
☒ No

List All Sensitive Environments Within ½ Mile of the Site: None – N/A

Distance	Sensitive Environment Type/Wetlands Area (acres)
Onsite	
0 - ¼ Mile	
> ¼ - ½ Mile	

GENERAL INFORMATION

Site Description and Operational History:

See pages 1 and 2.

Probable Substances of Concern:
(Previous investigations, analytical data)

See pages 1 and 2.

Site Sketch:
(Show all pertinent features, indicate sources and closest targets, indicate north)

See Figure 2

SOURCE EVALUATION

Source No.: 1	Source Name: Drums	Source Waste Quantity (WQ) Calculations:
Source Description: Five 55 gallon drums were present on-site. One had contents with a pH = 0 and the other four drums had contents with a pH = 13. The four caustic drums were leaking into a concrete drain. The acidic and caustic waste streams were seperated.		5 drums $\leq$ 1,000 drums $\therefore$ drums / 10 $\boxed{WQ = 0.5}$

Source No.: 2	Source Name: Non-drum Containers	Source Waste Quantity (WQ) Calculations:
Source Description: Five 6'x4'x5' plating vats were filled with burned debris and scrap metal. Rainwater that had filtered through the debris in one of the vats was leaking onto the concrete floor. The pH was 10.		1 Vat = 6'x4'x5' = 120 ft^3 $\therefore$ Total Volume = 600 ft^3 $\cong$ 4400 gallons WQ = Gallons / 500 $\boxed{WQ = 9}$

Source No.: 3	Source Name: Contaminated Soil	Source Waste Quantity (WQ) Calculations:
Source Description: A guesstimate of 20' x 100' = 2000 ft^2 of contaminated soil exists at the site. Elevated levels of total chromium and total nickel have been found at the site. Total chromium levels have been recorded up to 1,200 mg/kg and total nickel levels have been recorded up to 1,380 mg/kg.		2000 ft^2 < 3.4 million ft^2 $\therefore$ WQ = ft^2/34,000 $\boxed{WQ \cong 0.1}$

WQ_{Total} = 0.5 + 9 + 0.1
= 9.6
$\therefore$ WC = 18

Site WC:
18

PA TABLE 1: WASTE CHARACTERISTICS (WC) SCORES

PA Table 1a: WC Scores for Single Source Sites and Formulas for Multiple Source Sites

TIER	SOURCE TYPE	SINGLE SOURCE SITES (assigned WC scores) WC = 18	WC = 32	WC = 100	MULTIPLE SOURCE SITES Formula for Assigning Source WQ Values
CONSTITUENT	N/A	≤100 lb	>100 to 10,000 lb	>10,000 lb	*lb* ÷ *1*
WASTESTREAM	N/A	≤500,000 lb	>500,000 to 50 million lb	>50 million lb	*lb* ÷ *5,000*
VOLUME	Landfill	≤6.75 million ft^3 ≤250,000 yd^3	>6.75 million to 675 million ft^3 >250,000 to 25 million yd^3	>675 million ft^3 >25 million yd^3	ft^3 ÷ 67,500 yd^3 ÷ 2,500
	Surface impoundment	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3	>675,000 ft^3 >25,000 yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5
	Drums	≤1,000 drums	>1,000 to 100,000 drums	>100,000 drums	*drums* ÷ *10*
	Tanks and non-drum containers	≤50,000 gallons	>50,000 to 5 million gallons	>5 million gallons	*gallons* ÷ *500*
	Contaminated soil	≤6.75 million ft^3 ≤250,000 yd^3	>6.75 million to 675 million ft^3 >250,000 to 25 million yd^3	>675 million ft^3 >25 million yd^3	ft^3 ÷ 67,500 yd^3 ÷ 2,500
	Pile	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3	>675,000 ft^3 >25,000 yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5
	Other	≤6,750 ft^3 ≤250 yd^3	>6,750 to 675,000 ft^3 >250 to 25,000 yd^3	>675,000 ft^3 >25,000 yd^3	ft^3 ÷ 67.5 yd^3 ÷ 2.5
AREA	Landfill	≤340,000 ft^2 ≤7.8 acres	>340,000 to 34 million ft^2 >7.8 to 780 acres	>34 million ft^2 >780 acres	ft^2 ÷ 3,400 *acres* ÷ 0.078
	Surface impoundment	≤1,300 ft^2 ≤0.029 acres	>1,300 to 130,000 ft^2 >0.029 to 2.9 acres	>130,000 ft^2 >2.9 acres	ft^2 ÷ 13 *acres* ÷ 0.00029
	Contaminated soil	≤3.4 million ft^2 ≤78 acres	>3.4 million to 340 million ft^2 >78 to 7,800 acres	>340 million ft^2 >7,800 acres	ft^2 ÷ 34,000 *acres* ÷ 0.78
	Pile*	≤1,300 ft^2 ≤0.029 acres	>1,300 to 130,000 ft^2 >0.029 to 2.9 acres	>130,000 ft^2 >2.9 acres	ft^2 ÷ 13 *acres* ÷ 0.00029
	Land treatment	≤27,000 ft^2 ≤0.62 acres	>27,000 to 2.7 million ft^2 >0.62 to 62 acres	>2.7 million ft^2 >62 acres	ft^2 ÷ 270 *acres* ÷ 0.0062

1 ton = 2,000 lb = 1 yd^3 = 4 drums = 200 gallons

* Use area of land surface under pile, not surface area of pile.

PA Table 1b: WC Scores for Multiple Source Sites

WQ Total	*WC Score*
>0 to 100	18
>100 to 10,000	32
>10,000	100

GROUND WATER PATHWAY
GROUND WATER USE DESCRIPTION

Describe Ground Water Use Within 4-miles of the Site:
(Describe stratigraphy, information on aquifers, municipal and/or private wells)

See pages 3 and 4.

Calculations for Drinking Water Populations Served by Ground Water:

N/A

GROUND WATER PATHWAY CRITERIA LIST

SUSPECTED RELEASE

Yes	No	Unk	
X			Are sources poorly contained?
X			Is the source a type likely to contribute to ground water contamination (e.g., wet lagoon)?
	X		Is waste quantity particularly large?
X			Is precipitation heavy?
X			Is the infiltration rate high? Source 3 – soil Source 1 & 2 on concrete.
	X		Is the site located in an area of karst terrain?
X			Is the subsurface highly permeable or conductive?
	X		Is drinking water drawn from a shallow aquifer?
	X		Are suspected contaminants highly mobile in ground water? The metals are mobile w/ depressed groundwater pH.
		X	Does analytical or circumstantial evidence suggest ground water contamination?
			Other criteria? ______
X			**SUSPECTED RELEASE?**

PRIMARY TARGETS

Yes	No	Unk	
	X		Is any drinking water well nearby?
	X		Has any nearby drinking water well been closed?
	X		Has any nearby drinking water user reported foul-tasting or foul-smelling water?
	X		Does any nearby well have a large drawdown or high production rate?
	X		Is any drinking water well located between the site and other wells that are suspected to be exposed to a hazardous substance?
	X		Does analytical or circumstantial evidence suggest contamination at a drinking water well?
	X		Does any drinking water well warrant sampling?
			Other criteria? ______
	X		**PRIMARY TARGET(S) IDENTIFIED?**

Summarize the rationale for Suspected Release (attach an additional page if necessary):

Nickel and Chromium contamination has been detected in the soils. Due to the acidic conditions on-site the mobility of the metals may increase and be washed by rainwater infiltration down into the groundwater.

Summarize the rationale for Primary Targets (attach an additional page if necessary):

GROUND WATER PATHWAY SCORESHEET

Pathway Characteristics	
Do you suspect a release (see Ground Water Pathway Criteria List, page 7)?	Yes X No ___
Is the site located in karst terrain?	Yes ___ No X
Depth to aquifer: Aquifer not used for drinking water.	20 ft
Distance to the nearest drinking water well:	>4 miles

LIKELIHOOD OF RELEASE

	A Suspected Release	B No Suspected Release	References
1. SUSPECTED RELEASE: If you suspect a release to ground water (see page 7), assign a score of 550. Use only column A for this pathway.	(550) 550		
2. NO SUSPECTED RELEASE: If you do not suspect a release to ground water, and the site is in karst terrain or the depth to aquifer is 70 feet or less, assign a score of 500; otherwise, assign a score of 340. Use only column B for this pathway.		(500 or 340)	
LR =	550		

TARGETS

	A	B	References
3. PRIMARY TARGET POPULATION: Determine the number of people served by drinking water wells that you suspect have been exposed to a hazardous substance from the site (see Ground Water Pathway Criteria List, page 7). 0 people x 10 =	0		
4. SECONDARY TARGET POPULATION: Determine the number of people served by drinking water wells that you do NOT suspect have been exposed to a hazardous substance from the site, and assign the total population score from PA Table 2. Are any wells part of a blended system? Yes ___ No X If yes, attach a page to show apportionment calculations.	0		
5. NEAREST WELL: If you have identified a primary target population for ground water, assign a score of 50; otherwise, assign the Nearest Well score from PA Table 2. If no drinking water wells exist within 4 miles, assign a score of zero.	(50, 20, 16, 8, 5, 3, 2, or 0) 0	(20, 16, 8, 5, 3, 2, or 0)	
6. WELLHEAD PROTECTION AREA (WHPA): If any source lies within or above a WHPA, or if you have identified any primary target well within a WHPA, assign a score of 20; assign 5 if neither condition holds but a WHPA is present within 4 miles; otherwise assign zero.	(20, 5, or 0) 0	(20, 5, or 0)	
7. RESOURCES	(5 or 0) 5	(5 or 0)	
T =	5		

WASTE CHARACTERISTICS

	A	B
8. A. If you have identified any primary target for ground water, assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.	(100 or 32)	
B. If you have NOT identified any primary target for ground water, assign the waste characteristics score calculated on page 4.	(100, 32, or 18) 18	(100, 32, or 18)
WC =	18	

GROUND WATER PATHWAY SCORE: $\frac{LR \times T \times WC}{82{,}500}$ (subject to a maximum of 100) **0.6**

PA TABLE 2: VALUES FOR SECONDARY GROUND WATER TARGET POPULATIONS

PA Table 2a: Non-Karst Aquifers

N/A Population not served by groundwater.

Distance from Site	Population	Nearest Well (choose highest)	Population Served by Wells Within Distance Category: 1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	Greater than 100,000	Population Value
0 to ¼ mile	____	20	1	2	5	16	52	163	521	1,633	5,214	16,325	____
> ¼ to ½ mile	____	18	1	1	3	10	32	101	323	1,012	3,233	10,121	____
> ½ to 1 mile	____	9	1	1	2	5	17	52	167	522	1,668	5,224	____
> 1 to 2 miles	____	5	1	1	1	3	9	29	94	294	939	2,938	____
> 2 to 3 miles	____	3	1	1	1	2	7	21	68	212	678	2,122	____
> 3 to 4 miles	____	2	1	1	1	1	4	13	42	131	417	1,306	____

Nearest Well = ____ Score = ____

PA Table 2b: Karst Aquifers

Distance from Site	Population	Nearest Well (use 20 for karst)	Population Served by Wells Within Distance Category: 1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	Greater than 100,000	Population Value
0 to ¼ mile	____	20	1	2	5	16	52	163	521	1,633	5,214	16,325	____
> ¼ to ½ mile	____	20	1	1	3	10	32	101	323	1,012	3,233	10,121	____
> ½ to 1 mile	____	20	1	1	3	8	26	82	261	816	2,607	8,162	____
> 1 to 2 miles	____	20	1	1	3	8	26	82	261	816	2,607	8,162	____
> 2 to 3 miles	____	20	1	1	3	8	26	82	261	816	2,607	8,162	____
> 3 to 4 miles	____	20	1	1	3	8	26	82	261	816	2,607	8,162	____

Nearest Well = ____ Score = ____

SURFACE WATER PATHWAY
MIGRATION ROUTE SKETCH

Suface Water Migration Route Sketch:
(include runoff route, probable point of entry, 15-mile target distance limit, intakes, fisheries, and sensitive environments)

See Figure 2

SURFACE WATER PATHWAY CRITERIA LIST

SUSPECTED RELEASE

Yes	No	Unk	
☐	☒	☐	Is surface water nearby?
☐	☒	☐	Is waste quantity particularly large?
☐	☒	☐	Is the drainage area large?
☒	☐	☐	Is rainfall heavy?
☐	☒	☐	Is the infiltration rate low? Source 3 - soil Source 1 & 2 on concrete
☒	☐	☐	Are sources poorly contained or prone to runoff or flooding?
☐	☒	☐	Is a runoff route well defined (e.g., ditch or channel leading to surface water)? Overland flow to storm sewer.
☐	☐	☒	Is vegetation stressed along the probable run-off route? No Vegetation
☐	☐	☒	Are sediments or water unnaturally discolored? N/A
☐	☐	☒	Is wildlife unnaturally absent? N/A
☐	☐	☒	Has deposition of waste into surface water been observed? N/A - Runoff to storm sewer.
☐	☐	☒	Is ground water discharge to surface water likely? N/A
☐	☒	☐	Does analytical or circumstantial evidence suggest surface water contamination?
☐	☐		Other criteria? ______________
☐	☒		**SUSPECTED RELEASE?**

Summarize the rationale for Suspected Release (attach an additional page if necessary):

The surface water runoff enters a storm drain that is part of the city of Atlanta's sewer system. The storm drains are located on-site.

PRIMARY TARGETS

Yes	No	Unk	
☐	☒	☐	Is any target nearby? If yes: ☐ Drinking water intake ☐ Fishery ☐ Sensitive environment
☐	☒	☐	Has any intake, fishery, or recreational area been closed?
☐	☒	☐	Does analytical or circumstantial evidence suggest surface water contamination at or downstream of a target?
☐	☒	☐	Does any target warrant sampling? If yes: ☐ Drinking water intake ☐ Fishery ☐ Sensitive environment
☐	☐		Other criteria? ______________
☐	☒		**PRIMARY INTAKE(S) IDENTIFIED?**
☐	☒		**PRIMARY FISHERY(IES) IDENTIFIED?**
☐	☒		**PRIMARY SENSITIVE ENVIRONMENT(S) IDENTIFIED?**

Summarize the rationale for Primary Targets (attach an additional page if necessary):

SURFACE WATER PATHWAY
LIKELIHOOD OF RELEASE AND DRINKING WATER THREAT SCORESHEET

Pathway Characteristics
Do you suspect a release (see Surface Water Pathway Criteria List, page 11)? Yes ___ No X
Distance to surface water: N/A Runoff flows into city storm drain. N/A ft
Flood frequency: >500yr No Flooding
What is the downstream distance to the nearest drinking water intake? N/A miles
Nearest fishery? N/A miles Nearest sensitive environment? N/A miles

LIKELIHOOD OF RELEASE

	A *Suspected Release*	B *No Suspected Release*	*References*
1. SUSPECTED RELEASE: If you suspect a release to surface water (see page 11), assign a score of 550. Use only column A for this pathway.	(550)		
2. NO SUSPECTED RELEASE: If you do not suspect a release to surface water, use the table below to assign a score based on distance to surface water and flood frequency. Use only column B for this pathway.		(500, 400, 300, or 100) 100	
LR =	(550)	(500, 400, 300, or 100) 100	

Distance to surface water ≤ 2,500 feet	*500*
Distance to surface water > 2,500 feet, and	
Site in annual or 10-year floodplain	*500*
Site in 100-year floodplain	*400*
Site in 500-year floodplain	*300*
Site outside 500-year floodplain	*100*

DRINKING WATER THREAT TARGETS

3. Record the water body type, flow (if applicable), and number of people served by each drinking water intake within the target distance limit. If there is no drinking water intake within the target distance limit, factors 4, 5, and 6 each receive zero scores.

Intake Name	*Water Body Type*	*Flow*	*People Served*
		___ cfs	
		___ cfs	
		___ cfs	

	A	B	References
4. PRIMARY TARGET POPULATION: If you suspect any drinking water intake listed above has been exposed to a hazardous substance from the site (see Surface Water Pathway Criteria List, page 11), list the intake name(s) and calculate the factor score based on the total population served. ______________, ______________. ______ people x 10 =			
5. SECONDARY TARGET POPULATION: Determine the number of people served by drinking water intakes that you do NOT suspect have been exposed to a hazardous substance from the site, and assign the total population score from PA Table 3. Are any intakes part of a blended system? Yes ___ No X If yes, attach a page to show apportionment calculations.		0	
6. NEAREST INTAKE: If you have identified a primary target population for the drinking water threat (factor 4), assign a score of 50; otherwise, assign the Nearest Intake score from PA Table 3. If no drinking water intake exists within the target distance limit, assign a score of zero.	(50, 20, 10, 2, 1, or 0)	(20, 10, 2, 1, or 0) 0	
7. RESOURCES	(5 or 0)	(5 or 0) 5	
T =		5	

N/A Runoff immediately flows into a storm drain.

PA TABLE 3: VALUES FOR SECONDARY SURFACE WATER TARGET POPULATIONS

Surface Water Body Flow (see PA Table 4)	*Population*	*Nearest Intake (choose highest)*	*Population Served by Intakes Within Flow Category* 1 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	Greater than 1,000,000	*Population Value*
<10 cfs	______	20	2	5	16	52	163	521	1,633	5,214	16,325	52,136	163,246	______
10 to 100 cfs	______	2	1	1	2	5	16	52	163	521	1,633	5,214	16,325	______
>100 to 1,000 cfs	______	1	0	0	1	1	2	5	16	52	163	521	1,633	______
>1,000 to 10,000 cfs	______	0	0	0	0	0	1	1	2	5	16	52	163	______
>10,000 cfs or Great Lakes	______	0	0	0	0	0	0	0	1	1	2	5	16	______
3-mile Mixing Zone	______	10	1	3	8	26	82	261	816	2,607	8,162	26,068	81,663	______

Nearest Intake =

Score =

PA TABLE 4: SURFACE WATER TYPE / FLOW CHARACTERISTICS WITH DILUTION WEIGHTS FOR SECONDARY SURFACE WATER SENSITIVE ENVIRONMENTS

Type of Surface Water Body *Water Body Type*	*OR*	*Flow*	*Dilution Weight*
minimal stream		< 10 cfs	*1*
small to moderate stream		10 to 100 cfs	*0.1*
moderate to large stream		> 100 to 1,000 cfs	*N/A*
large stream to river		> 1,000 to 10,000 cfs	*N/A*
large river		> 10,000 cfs	*N/A*
3-mile mixing zone of quiet flowing streams or rivers		10 cfs or greater	*N/A*
coastal tidal water (harbors, sounds, bays, etc.), ocean, or Great Lakes		N/A	*N/A*

SURFACE WATER PATHWAY (continued)
HUMAN FOOD CHAIN THREAT SCORESHEET

LIKELIHOOD OF RELEASE		A: *Suspected Release*	B: *No Suspected Release*	*References*
Enter Surface Water Likelihood of Release score from page 12.	LR =		100	

HUMAN FOOD CHAIN THREAT TARGETS

8. Record the water body type and flow (if applicable) for each fishery within the target distance limit. If there is no fishery within the target distance limit, assign a Targets score of 0 at the bottom of the page.

Fishery Name	*Water Body Type*	*Flow*
		cfs
		cfs
		cfs
		cfs
		cfs

9. **PRIMARY FISHERIES:** If you suspect any fishery listed above has been exposed to a hazardous substance from the site (see Surface Water Criteria List, page 11), assign a score of 300 and do not evaluate Factor 10. List the primary fisheries:

____________________, ____________________,
____________________, ____________________.

10. SECONDARY FISHERIES

A. If you suspect a release to surface water and have identified a secondary fishery but no primary fishery, assign a score of 210.

B. If you do not suspect a release, assign a Secondary Fisheries score from the table below using the lowest flow at any fishery within the target distance limit.

Lowest Flow	*Secondary Fisheries Score*
< 10 cfs	210
10 to 100 cfs	30
> 100 cfs, coastal tidal waters, oceans, or Great Lakes	12

Secondary Fisheries score (column B): 12

Chattahoochee

T = | A: | B: 12

SURFACE WATER PATHWAY (continued)
ENVIRONMENTAL THREAT SCORESHEET

LIKELIHOOD OF RELEASE		A Suspected Release	B No Suspected Release	References
Enter Surface Water Likelihood of Release score from page 12.	LR =		100	

ENVIRONMENTAL THREAT TARGETS

11. Record the water body type and flow (if applicable) for each surface water sensitive environment within the target distance limit (see PA Tables 4 and 5). If there is no sensitive environment within the target distance limit, assign a Targets score of 0 at the bottom of the page.

Environment Name	*Water Body Type*	*Flow*
		cfs
		cfs
		cfs
		cfs
		cfs

12. PRIMARY SENSITIVE ENVIRONMENTS: If you suspect any sensitive environment listed above has been exposed to a hazardous substance from the site (see Surface Water Criteria List, page 11), assign a score of 300 and do not evaluate factor 13. List the primary sensitive environments:

_______________, _______________,
_______________, _______________.

13. SECONDARY SENSITIVE ENVIRONMENTS: If sensitive environments are present, but none is a primary sensitive environment, evaluate Secondary Sensitive Environments based on flow.

A. For secondary sensitive environments on surface water bodies with flows of 100 cfs or less, assign scores as follows, and do not evaluate part B of this factor:

Flow	*Dilution Weight (PA Table 4)*		*Environment Type and Value (PA Tables 5 and 6)*		*Total*
cfs		x		=	
cfs		x		=	
cfs		x		=	
cfs		x		=	
cfs		x		=	

Sum =

B. If all secondary sensitive environments are located on surface water bodies with flows > 100 cfs, assign a score of 10.

	A	B
13B score		10
T =		10

PA TABLE 5: SURFACE WATER AND AIR PATHWAY SENSITIVE ENVIRONMENTS VALUES

Sensitive Environment	Assigned Value
Critical habitat for Federally designated endangered or threatened species Marine Sanctuary National Park Designated Federal Wilderness Area Ecologically important areas identified under the Coastal Zone Wilderness Act Sensitive Areas identified under the National Estuary Program or Near Coastal Water Program of the Clean Water Act Critical Areas identified under the Clean Lakes Program of the Clean Water Act (subareas in lakes or entire small lakes) National Monument (air pathway only) National Seashore Recreation Area National Lakeshore Recreation Area	100
Habitat known to be used by Federally designated or proposed endangered or threatened species National Preserve National or State Wildlife Refuge Unit of Coastal Barrier Resources System Federal land designated for the protection of natural ecosystems Administratively Proposed Federal Wilderness Area Spawning areas critical for the maintenance of fish/shellfish species within a river system, bay, or estuary Migratory pathways and feeding areas critical for the maintenance of anadromous fish species in a river system Terrestrial areas utilized for breeding by large or dense aggregations of vertebrate animals (air pathway) or semi-aquatic foragers (surface water pathway) National river reach designated as Recreational	75
Habitat known to be used by State designated endangered or threatened species Habitat known to be used by a species under review as to its Federal endangered or threatened status Coastal Barrier (partially developed) Federally designated Scenic or Wild River	50
State land designated for wildlife or game management State designated Scenic or Wild River State designated Natural Area Particular areas, relatively small in size, important to maintenance of unique biotic communities	25
State designated areas for protection/maintenance of aquatic life under the Clean Water Act	5
Wetlands	See PA Table 6 (Surface Water Pathway) or PA Table 9 (Air Pathway)

PA TABLE 6: SURFACE WATER PATHWAY WETLANDS FRONTAGE VALUES

Total Length of Wetlands	Assigned Value
Less than 0.1 mile	0
0.1 to 1 mile	25
Greater than 1 to 2 miles	50
Greater than 2 to 3 miles	75
Greater than 3 to 4 miles	100
Greater than 4 to 8 miles	150
Greater than 8 to 12 miles	250
Greater than 12 to 16 miles	350
Greater than 16 to 20 miles	450
Greater than 20 miles	500

SURFACE WATER PATHWAY (concluded)
WASTE CHARACTERISTICS, THREAT, AND PATHWAY SCORE SUMMARY

WASTE CHARACTERISTICS

	A *Suspected Release*	B *No Suspected Release*
14. A. If you have identified any primary target for surface water (pages 12, 14, or 15), assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.	(100 or 32)	
B. If you have NOT identified any primary target for surface water, assign the waste characteristics score calculated on page 4.	(100, 32, or 18)	(100, 32, or 18) 18
WC =		18

SURFACE WATER PATHWAY THREAT SCORES

Threat	*Likelihood of Release (LR) Score (from page 12)*	*Targets (T) Score (pages 12, 14, 15)*	*Pathway Waste Characteristics (WC) Score (determined above)*	*Threat Score LR x T x WC / 82,500*
Drinking Water	100	5	18	(subject to a maximum of 100) 0.11
Human Food Chain	100	12	18	(subject to a maximum of 100) 0.26
Environmental	100	10	18	(subject to a maximum of 60) 0.22

SURFACE WATER PATHWAY SCORE **(Drinking Water Threat + Human Food Chain Threat + Environmental Threat)**	(subject to a maximum of 100) 0.59

SOIL EXPOSURE PATHWAY CRITERIA LIST

SUSPECTED CONTAMINATION	RESIDENT POPULATION			
	Yes	No	Unk	
Surficial contamination can generally be assumed.	☐	☒	☐	Is any residence, school, or daycare facility on or within 200 feet of an area of suspected contamination?
	☐	☒	☐	Is any residence, school, or daycare facility located on adjacent land previously owned or leased by the site owner/operator?
	☐	☒	☐	Is there a migration route that might spread hazardous substances near residences, schools, or daycare facilities?
	☐	☒	☐	Have onsite or adjacent residents or students reported adverse health effects, exclusive of apparent drinking water or air contamination problems?
	☐	☒	☐	Does any neighboring property warrant sampling?
	☐	☐		Other criteria? ______________
	☐	☒		**RESIDENT POPULATION IDENTIFIED?**

Summarize the rationale for Resident Population (attach an additional page if necessary):

SOIL EXPOSURE PATHWAY SCORESHEET

Pathway Characteristics		
Do any people live on or within 200 ft of areas of suspected contamination?	Yes ___	No X
Do any people attend school or daycare on or within 200 ft of areas of suspected contamination?	Yes ___	No X
Is the facility active? Yes ___ No X If yes, estimate the number of workers: ______		

The facility is remodeling the front portion.

LIKELIHOOD OF EXPOSURE

	Suspected Contamination	References
1. SUSPECTED CONTAMINATION: Surficial contamination can generally be assumed, and a score of 550 assigned. Assign zero only if the absence of surficial contamination can be confidently demonstrated. LE =	550	___

RESIDENT POPULATION THREAT TARGETS

2. RESIDENT POPULATION: Determine the number of people occupying residences or attending school or daycare on or within 200 feet of areas of suspected contamination (see Soil Exposure Pathway Criteria List, page 18).

_0_ people x 10 = **0** ___

3. RESIDENT INDIVIDUAL: If you have identified a resident population (factor 2), assign a score of 50; otherwise, assign a score of 0. **0** ___

4. WORKERS: Use the following table to assign a score based on the total number of workers at the facility and nearby facilities with suspected contamination:

Number of Workers	*Score*
0	0
1 to 100	5
101 to 1,000	10
> 1,000	15

The nearby facilities have access to the site. No workers at US Plating.

5 ___

5. TERRESTRIAL SENSITIVE ENVIRONMENTS: Use PA Table 7 to assign a value for each terrestrial sensitive environment on an area of suspected contamination:

Terrestrial Sensitive Environment Type	*Value*
______	___
______	___

Sum = **0** ___

6. RESOURCES **5** ___

T = **10**

WASTE CHARACTERISTICS

7. Assign the waste characteristics score calculated on page 4. WC = **18**

RESIDENT POPULATION THREAT SCORE: $\frac{LE \times T \times WC}{82{,}500}$ = **1.2**

NEARBY POPULATION THREAT SCORE: **2** ___

SOIL EXPOSURE PATHWAY SCORE:
Resident Population Threat + Nearby Population Threat = **3.2**

PA TABLE 7: SOIL EXPOSURE PATHWAY TERRESTRIAL SENSITIVE ENVIRONMENT VALUES

Terrestrial Sensitive Environment	*Assigned Value*
Terrestrial critical habitat for Federally designated endangered or threatened species National Park Designated Federal Wilderness Area National Monument	100
Terrestrial habitat known to be used by Federally designated or proposed threatened or endangered species National Preserve (terrestrial) National or State terrestrial Wildlife Refuge Federal land designated for protection of natural ecosystems Administratively proposed Federal Wilderness Area Terrestrial areas utilized by large or dense aggregations of animals (vertebrate species) for breeding	75
Terrestrial habitat used by State designated endangered or threatened species Terrestrial habitat used by species under review for Federal designated endangered or threatened status	50
State lands designated for wildlife or game management State designated Natural Areas Particular areas, relatively small in size, important to maintenance of unique biotic communities	25

AIR PATHWAY CRITERIA LIST	
SUSPECTED RELEASE	***PRIMARY TARGETS***
Yes / No / Unk ☐ ☒ ☐ Are odors currently reported? ☐ ☒ ☐ Has release of a hazardous substance to the air been directly observed? ☐ ☒ ☐ Are there reports of adverse health effects (e.g., headaches, nausea, dizziness) potentially resulting from migration of hazardous substances through the air? ☐ ☒ ☐ Does analytical or circumstantial evidence suggest a release to the air? ☐ ☐ Other criteria? ____________ ☐ ☒ **SUSPECTED RELEASE?**	If you suspect a release to air, evaluate all populations and sensitive environments within 1/4 mile (including those onsite) as primary targets.

Summarize the rationale for Suspected Release (attach an additional page if necessary):

AIR PATHWAY SCORESHEET

Pathway Characteristics	
Do you suspect a release (see Air Pathway Criteria List, page 21)?	Yes ___ No X
Distance to the nearest individual: Next door facilities have access to the US Plating Burn Site	0 ft

	A *Suspected Release*	B *No Suspected Release*	*References*
LIKELIHOOD OF RELEASE			
1. SUSPECTED RELEASE: If you suspect a release to air (see page 21), assign a score of 550. Use only column A for this pathway.	(550)		
2. NO SUSPECTED RELEASE: If you do not suspect a release to air, assign a score of 500. Use only column B for this pathway.		(500) 500	
LR =		500	
TARGETS			
3. PRIMARY TARGET POPULATION: Determine the number of people subject to exposure from a suspected release of hazardous substances to the air. ___ people x 10 =			
4. SECONDARY TARGET POPULATION: Determine the number of people not suspected to be exposed to a release to air, and assign the total population score using PA Table 8.		81	
5. NEAREST INDIVIDUAL: If you have identified any Primary Target Population for the air pathway, assign a score of 50; otherwise, assign the Nearest Individual score from PA Table 3.	(50, 20, 7, 2, 1, or 0)	(20, 7, 2, 1, or 0) 20	
6. PRIMARY SENSITIVE ENVIRONMENTS: Sum the sensitive environment values (PA Table 5) and wetland acreage values (PA Table 9) for environments subject to exposure from a suspected release to the air.			
Sum =			
7. SECONDARY SENSITIVE ENVIRONMENTS: Use PA Table 10 to determine the score for secondary sensitive environments.		0	
8. RESOURCES	(5 or 0)	(5 or 0) 5	
T =		106	
WASTE CHARACTERISTICS			
9. A. If you have identified any Primary Target for the air pathway, assign the waste characteristics score calculated on page 4, or a score of 32, whichever is GREATER; do not evaluate part B of this factor.	(100 or 32)		
B. If you have NOT identified any Primary Target for the air pathway, assign the waste characteristics score calculated on page 4.	(100, 32, or 18)	(100, 32, or 18) 18	
WC =		18	

Sensitive Environment Type	Value

AIR PATHWAY SCORE: $\frac{LR \times T \times WC}{82{,}500}$ = (subject to a maximum of 100) 11.56

PA TABLE 8: VALUES FOR SECONDARY AIR TARGET POPULATIONS

Distance from Site	Population	Nearest Individual (choose highest)	1 to 10	11 to 30	31 to 100	101 to 300	301 to 1,000	1,001 to 3,000	3,001 to 10,000	10,001 to 30,000	30,001 to 100,000	100,001 to 300,000	300,001 to 1,000,000	Greater than 1,000,000	Population Value
			Population Within Distance Category												
Nearby Workers Onsite	50	20	1	2	5	16	52	163	521	1,633	5,214	16,325	52,136	163,246	5
>0 to ¼ mile	611	20	1	1	1	4	13	41	130	408	1,303	4,081	13,034	40,811	13
>¼ to ½ mile	2020	2	0	0	1	1	3	9	28	88	282	882	2,815	8,815	9
>½ to 1 mile	8473	1	0	0	0	1	1	3	8	26	83	261	834	2,612	8
>1 to 2 miles	35,570	0	0	0	0	0	1	1	3	8	27	83	266	833	27
>2 to 3 miles	49,372	0	0	0	0	0	1	1	1	4	12	38	120	376	12
>3 to 4 miles	73,687	0	0	0	0	0	0	1	1	2	7	23	73	229	7

Nearest Individual = 20

Score = 81

PA TABLE 9: AIR PATHWAY VALUES FOR WETLAND AREA

Wetland Area	Assigned Value
Less than 1 acre	0
1 to 50 acres	25
Greater than 50 to 100 acres	75
Greater than 100 to 150 acres	125
Greater than 150 to 200 acres	175
Greater than 200 to 300 acres	250
Greater than 300 to 400 acres	350
Greater than 400 to 500 acres	450
Greater than 500 acres	500

PA TABLE 10: DISTANCE WEIGHTS AND CALCULATIONS FOR AIR PATHWAY SECONDARY SENSITIVE ENVIRONMENTS

N/A No sensitive environments within a ½ mile radius.

Distance	Distance Weight	Sensitive Environment Type and Value (from PA Table 5 or 9)	Product
Onsite	0.10	x	
		x	
0-1/4 mi	0.025	x	
		x	
		x	
1/4-1/2mi	0.0054	x	
		x	
		x	
		x	

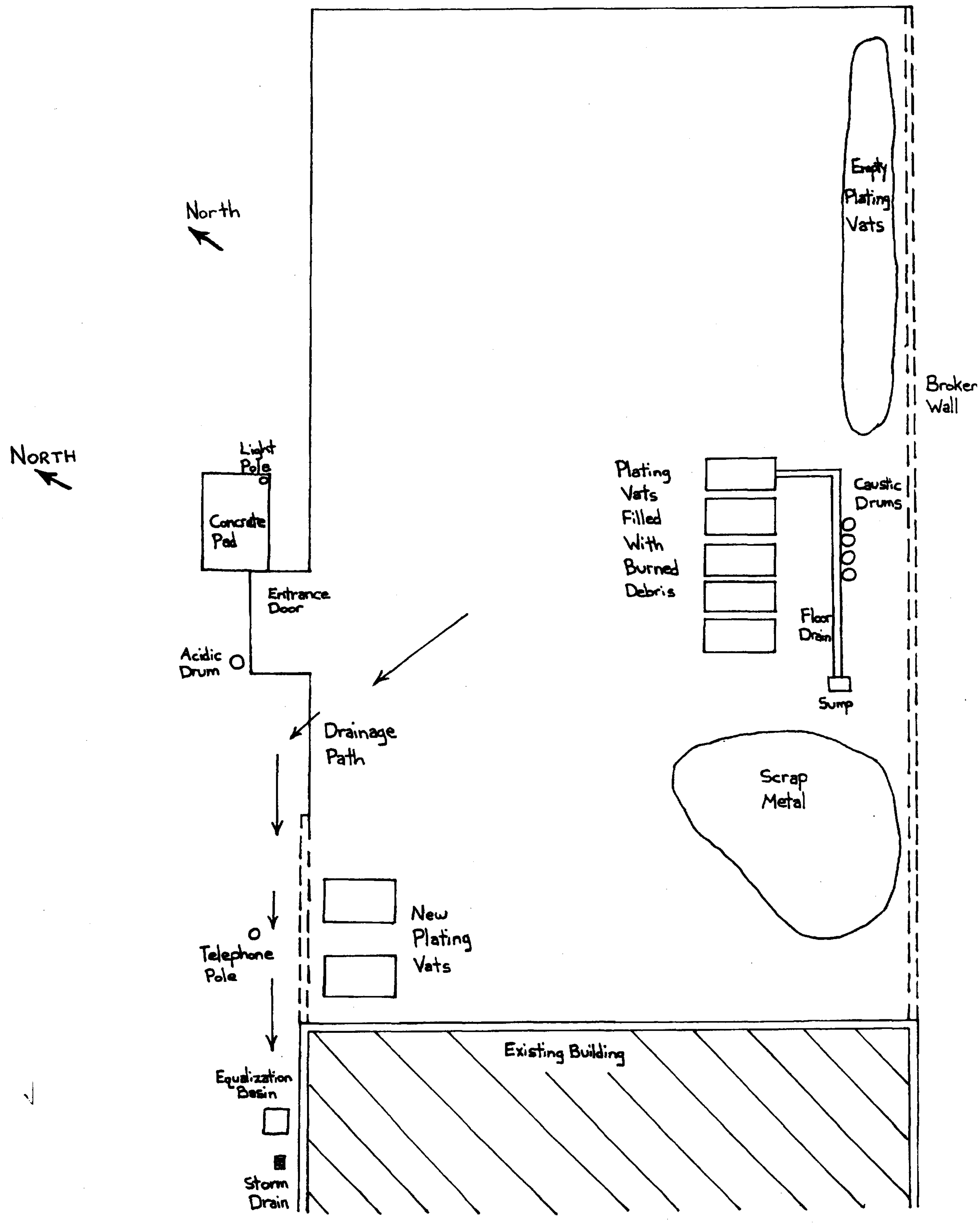
Total Environments Score = 0

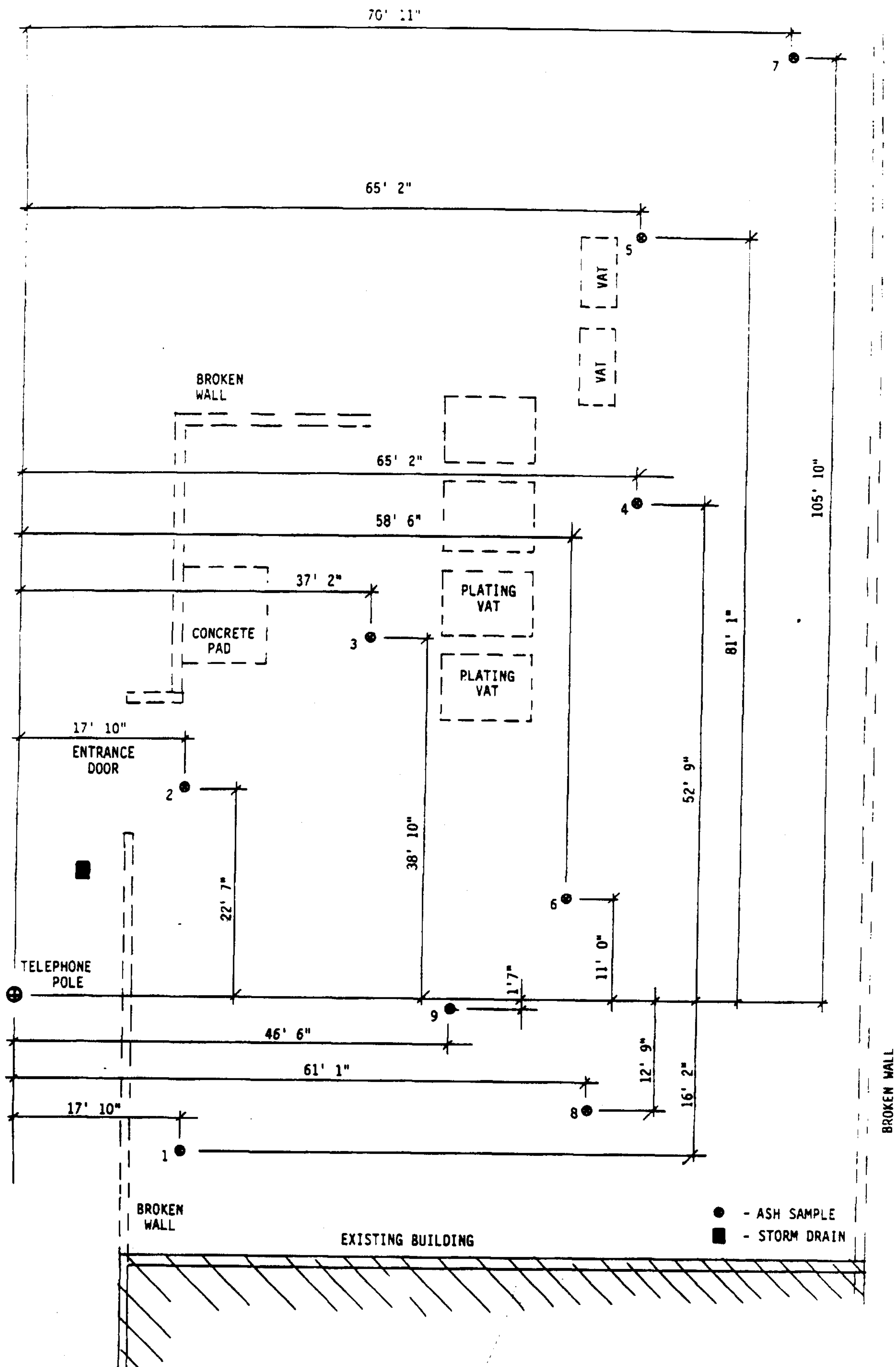
SITE SCORE CALCULATION

	S	S^2
GROUND WATER PATHWAY SCORE (S_{gw}):	0.6	0.36
SURFACE WATER PATHWAY SCORE (S_{sw}):	0.59	0.35
SOIL EXPOSURE PATHWAY SCORE (S_s):	3.2	10.24
AIR PATHWAY SCORE (S_a):	11.56	133.63
SITE SCORE:	$\sqrt{\frac{S_{gw}^2+S_{sw}^2+S_s^2+S_a^2}{4}}$	6.0

SUMMARY

	YES	NO
1. Is there a high possibility of a threat to any nearby drinking water well(s) by migration of a hazardous substance in ground water?	☐	☒
A. If yes, identify the well(s). ______		
B. If yes, how many people are served by the threatened well(s)? ______		
2. Is there a high possibility of a threat to any of the following by hazardous substance migration in surface water?		
A. Drinking water intake	☐	☒
B. Fishery	☐	☒
C. Sensitive environment (wetland, critical habitat, others)	☐	☒
D. If yes, identify the target(s). ______		
3. Is there a high possibility of an area of surficial contamination within 200 feet of any residence, school, or daycare facility? If yes, identify the property(ies) and estimate the associated population(s). ______	☐	☒
4. Are there public health concerns at this site that are not addressed by PA scoring considerations? If yes, explain: ______	☐	☒


North
NORTH
Empty Plating Vats
Broken Wall
Light Pole
Concrete Pad
Plating Vats Filled With Burned Debris
Caustic Drums
Entrance Door
Acidic Drum
Floor Drain
Sump
Drainage Path
Scrap Metal
New Plating Vats
Telephone Pole
Existing Building
Equalization Basin
Storm Drain

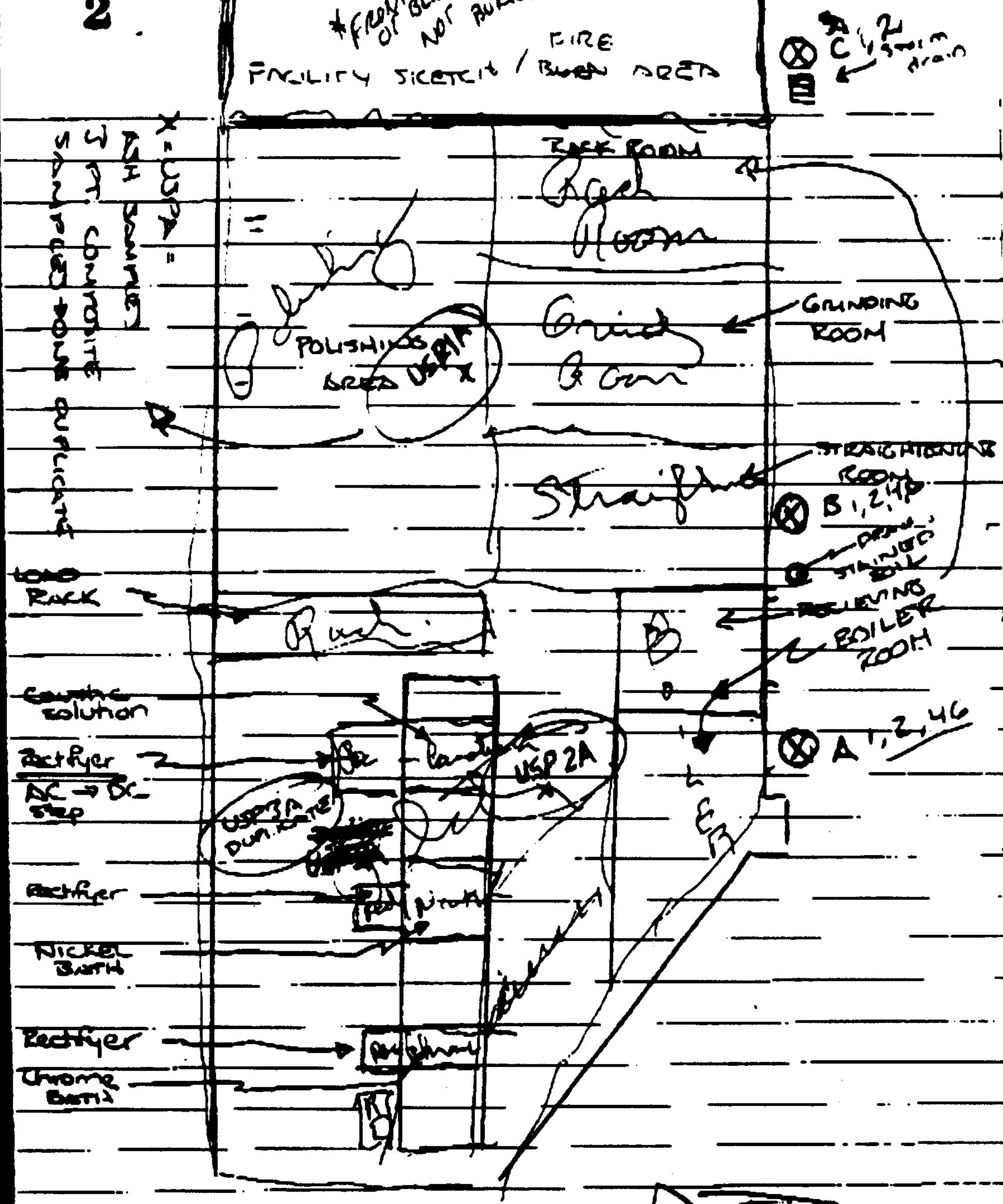


CONVERSION TECHNOLOGY, INC. 3300 Holcomb Bridge Rd, Suite 250 Norcross, Georgia 30092 (404) 263-6330	Dwg. Name: ASH SAMPLE LOCATIONS			Drawn: ANL			
				Approved: SWM			
	No.:			Date: 8/17/92			
Project: U.S. PLATING & BUMPER SERVICE	Sheet 1/1	Scale 1"=10'	Rev.	Build	Bid	Read X	

2

*FRONT OF BLDG NOT BURNED

FACILITY SKETCH / FIRE BURN AREA



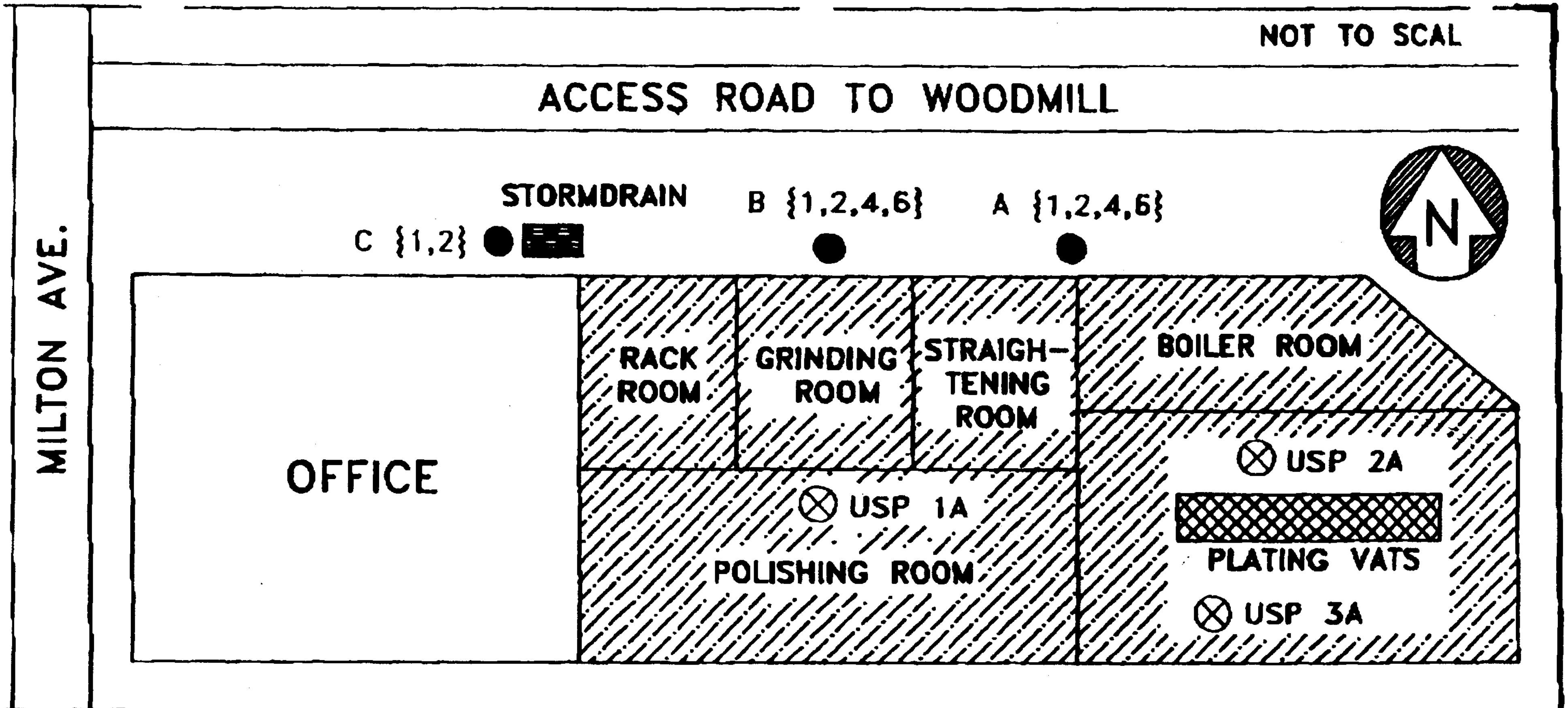
1310 TAT's, OSC DEPART SITE

NOT USED

⊗ SOIL SAMPLE

SAMPLES COLLECTED @ 1, 2, 4, 6 @ pts A & B

TAT COLLECTED SPLIT @ C-1



U.S. PLATING SITE

ATLANTA, FULTON COUNTY, GEORGIA

TDD# 04-9208-0005

SITE DIAGRAM/SAMPLING LOCATION MAP

LEGEND

● SOIL SAMPLE (GRAB) [C-1,C-2;A-1,A-2: SPLITS WITH PRP]

⊗ ASH SAMPLE COMPOSITE

BURNED AREA

UNSCANNABLE

MEDIA

(PHOTOGRAPHS)

THESE ARE THE CLOSEST MATCHES IN THE CITY OF ATLANTA

_ UNITED STATES PLATING & BUMPER 78 MILTON AVE SE 003289824 S
U S PLATING (TRADE STYLE) T

TO PICK A COMPANY, TYPE ITS LINE NUMBER FROM ABOVE, OR:

L = CONDUCT AUTOMATIC NAME VARIATION SEARCH IN ATLANTA
V = VARY YOUR ENTRY, AND TRY AGAIN (PHONE # OR NAME)
X = EXTEND SEARCH TO THE ENTIRE STATE OF GA
I = HAVE D&B INVESTIGATE THIS COMPANY
CAN = TO MOVE TO YOUR NEXT INQUIRY

RECEIVED
1 2 1993
ENVIRONMENTAL PROTECTION
HAZARDOUS WASTE MGMT

ENTER YOUR SELECTION, THEN PRESS <RETURN>: 1

A=CREDIT ADVISORY SYSTEM	P=PAYMENT ANALYSIS REPT	M=MAI
F=BUSINESS INFO REPORT	D=FINANCIAL PRODUCT MENU	CAN=MOVE TO NEXT INQUIRY
S=SUMMARY REPORT	C=CREDIT GUIDE	MNU=RETURN SERVICE MENU
R=RATING & VERIFICATION	T=FAMILY TREE	
	G=GOVT ACTIVITY REPT	

ENTER SELECTION: f

WHO IS THIS REPORT FOR? (ENTER NAME, POLICY NUMBER,
OR OTHER IDENTIFICATION) OR <RETURN>: charlie x3931

PRINT NOW (Y OR N): y

FOR THE EXCLUSIVE USE OF SUBSCRIBER 069-005080L.

ATTN: CHARLIE X3931

IN DATE

DUNS: 00-328-9824	DATE PRINTED		
UNITED STATES PLATING & BUMPER SERVICE INC	SEP 03 1992	RATING	--
U S PLATING	INDUSTRIAL AND COMMERCIAL ELECTROPLATING	STARTED	1960
		PAYMENTS	SEE BELOW
78 MILTON AVE SE		EMPLOYS	10
ATLANTA GA 30315	SIC NO.	HISTORY	INCOMPLETE
TEL: 404 627-5703	34 71		

CHIEF EXECUTIVE: JEANETTE C GAGE, PRES

S CIAL EVENTS
08/12/92 According to published reports verified by sources contacted, the company endured a fire on July 31, 1992. Sources contacted indicated that operations are still being conducted. Further details were not disclosed.

PAYMENTS (Amounts may be rounded to nearest figure in prescribed ranges)

REPORTED	PAYING RECORD	HIGH CREDIT	NOW OWES	PAST DUE	SELLING TERMS	LAST SALE WITHIN
07/92	Disc	50	-0-	-0-	2 10 N30	1 Mo
	Ppt	50	-0-	-0-	N30	6-12 Mos
06/92	Ppt	500	-0-	-0-		2-3 Mos
05/92	Disc	50	-0-	-0-		6-12 Mos
03/92	(005)	2500	750	-0-		
12/91	Ppt	250			N30	

* Each experience shown represents a separate account reported by a supplier. Updated trade experiences replace those previously reported.

FINANCE

06/12/91 On JUN 12 1991 Jeanette C Gage, president, declined financial information.

HISTORY

06/12/91

JEANETTE C GAGE, PRES
DIRECTOR(S): THE OFFICER(S)

CORPORATE AND BUSINESS REGISTRATIONS REPORTED BY THE SECRETARY OF STATE OR OTHER OFFICIAL SOURCE AS OF 08/18/1992:

BUSINESS TYPE: Corporation - Profit

DATE INCORPORATED: 07/25/1960
STATE OF INCORP: Georgia

Business started 1960.
JEANETTE C GAGE born 1926. 1960-present active here.

OPERATION

06/12/91 Industrial and commercial electroplating service specializing in straightening, polishing and chrome-plating motorcycle parts, automobile bumpers, antique car parts and other industrial and commercial plating (100%).
Terms are net 30 days. Has 50 accounts. Sells to wholesalers, body shops and general public. Territory : Southeastern United States. Nonseasonal.

EMPLOYEES: 10 including officers.

FACILITIES: Owns 20,000 sq. ft. in 1 story frame building in normal condition.

LOCATION: Suburban business section on side street.

09-03(10D /106) 00000 069114114

FULL DISPLAY COMPLETE

_ Other:

Activities

x Incoming Call	_ Public Meeting	x Health Consult*	x Site Visit
_ Outgoing Call	_ Other Meeting	_ Health Referral	x Info Provided
_ Conference Call	_ Data Review	_ Written Response	_ Training
_ Incoming Mail	_ Other:		

Requestor and Affiliation: (1) Charlie Stevens, EPA Region IV OSC
Phone: 404-347-3931 Address: ______
City: Atlanta State: GA Zip Code: ______

Contacts and Affiliation

(31) Carl Blair, Region 4 Rep. ( ) ______
( ) ______ ( ) ______

1-EPA	2-USCG	3-OTHER FED	4-STATE ENV	5-STATE HLT	6-COUNTY HLT
7-CITY HLTH		8-HOSPITAL	9-LAW ENFORCE	10-FIRE DEPT	11-POISON CTR
12-PRIV CITZ		13-OTHER	14-UNKNOWN	15-DOD	16-DOE
17-NOAA		18-OTHR STATE	19-OTHR CNTY	20-OTHR CITY	21-INTL
22-CITZ GROUP		23-ELECT. OFF	24-PRIV. CO	25-NEWS MEDIA	26-ARMY
27-NAVY		28-AIR FORCE	29-DEF LOG AGCY	30-NRC	31-ATSDR

Program Areas

_ Health Assessment	_ Health Studies	_ Tox Info-profile
_ Worker Hlth	_ Petition Assessment	_ Health Survellnc
_ Tox Info-Nonprofil	_ Admin	_ Emergency Response
_ Disease Regstry	_ Subst-Spec Resch	_ Other
x Health Consultation	_ Exposr Regstry	_ Health Education

Narrative Summary:

Region IV, EPA has requested that ATSDR evaluate ash and soil sampling data collected August 7 and 10, 1992, from an electroplating facility and to determine if the levels of contaminants in the samples pose a threat to public health. U.S. Plating is in an industrial area located at 78 Milton Ave., S.E., Atlanta, Georgia. The ash and soil samples were collected on-site following a fire in the production area of the site on July 30, 1992.

On September 22, 1992, I spoke to Charlie Stevens (EPA Region IV OSC) to verify the depths at which the ash was sampled, and to inquire about groundwater use near the site. He indicated that, to his knowledge, no groundwater wells were located in the area.

The on-site ash composite samples (collected at depths of 0-3", made up of 3 aliquots taken at random locations) and soil grab samples (collected at depths of 1 foot and 2 feet) were analyzed for total metals, TCLP metals, and pH (see attachment).

The maximum contaminant concentrations detected in ash composite surface samples were as follows: total chromium 2,000 parts per million (ppm) and total nickel 15,400 ppm. The pH analyses of the composite ash surface samples indicated a minimum pH of 0.35 (sample# USP-2A). TCLP leachate analyses indicated total chromium detected at a maximum of 68.5 ppm (sample# USP-3A).

The acidic conditions detected on-site may increase the mobility of the metals (nickel, chromium) in the soil and cause them to vertically migrate into groundwater.

After reviewing the data, ATSDR has determined that feasible human exposure scenarios to the contaminated ash in surface soils are through inhalation, ingestion, and dermal exposures. Since the site is located in an industrial setting and access to the site is restricted by a fence, an acute exposure scenario of a sensitive population (e.g., children) to site related contamination is unlikely. Occupational exposures are most likely at this site.

<u>Action Required/Recommendations/Info Provided</u>:

Based on the on-site data reviewed, ATSDR concludes, that the levels of nickel and chromium contamination in surface soils may pose a potential human health threat to on-site and nearby workers. However, additional sampling is recommended to determine the species of chromium present, as this would assist ATSDR in determining the degree of health threat posed by exposure to the chromium in the ash.

Based on the nature of the surface soil contamination, ATSDR recommends that measures be taken to prevent off-site migration of contaminants during any remedial or construction activities on-site.

.ERCB Log# 4103

In addition, ATSDR also recommends air monitoring at the site during remediation or construction activities, as this would provide information needed to determine the degree of health threat posed by inhalation exposure to the contamination in the ash.

Signature: Tammie McRae Date: 9-25-92

Concurrence: Ph.D. Date: 9-25-92

Enclosures: Yes (x) No ( ); MIS entered: Yes (x) No ( )

cc: E. Skowronski
ATSDR Region 4 Rep., Carl Blair

```
èëëëëëëë VIEW ëëëëëëëëëëë£          EVENT SUMMARY          èëëëëë SCREEN 1 OF 1 ëëëë£
¤                         àëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥                                  ¤
¤Ö áááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááá¢¤
¤        REF NO.: 05958                                    EPA ID: GAD984282301         °¤
¤°        OPUNIT: 00                                   SITE NAME: US PLATING BURN SITE  °¤
¤°         EVENT: DS1                                 EVENT NAME: DISCOVERY             °¤
¤âááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì¤
¤Öááááááááááááááááááááááááááááááá EVENT DATA ááááááááááááááááááááááááááááááááááááá¢¤
¤°      EVENT LEAD: RP                                                                  °¤
¤°       SCAP NOTE:                                                                     °¤
¤°                                                                                      °¤
¤°                                                                                      °¤
¤°                                  COMPLETE                                            °¤
¤°        PLANNED:                    /  /                                              °¤
¤°         ACTUAL:                  09/01/92                                            °¤
¤°                                                                                      °¤
¤°                                                                                      °¤
¤°                                             FIRST COMPLETE INDICATOR: A              °¤
¤°                                                                                      °¤
¤°   CONTACT NAME: CHARLIE STEVENS, OSC          CONTACT NO.: (404) 347-3931            °¤
¤ûáááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááÇ¤
¤°                                                                                      °¤
¤âáááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááááì¤
àëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥
             Menu options             Edit            Leave            Quit        [M]
```

```
èëëëëëëë VIEW ëëëëëëëëëëë£         SITE SUMMARY        èëëëëë SCREEN 1 OF 2 ëëëë£
¤                           àëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥                        ¤
¤           REF NO.: 05958                                EPA ID: GAD984282301  ¤
¤       IFMS ID NO.: 040P                                                       ¤
¤              NAME: US PLATING BURN SITE                                       ¤
¤            STREET: 78 MILTON AVENUE, SE                                       ¤
¤              CITY: ATLANTA                                                    ¤
¤             STATE: GA                                ZIP CODE: 30315-         ¤
¤       COUNTY NAME: FULTON                         COUNTY CODE: 121            ¤
¤  CONGRESS DISTRICT: 05                      FED FACILITY INDIC: N              ¤
¤   OWNER INDICATOR: UN                                RCRA FLAG:               ¤
¤          LATITUDE: 33 42 24.0                        LONGITUDE: 084 23 12.0   ¤
¤   LAT/LONG SOURCE: G                             INCIDENT TYPE:               ¤
¤   USGS HYDRO UNIT: 03070103                     METROSTAT AREA: 0520          ¤
¤  NPL STATUS INDIC: N                       COST RECOVERY INDIC: E             ¤
¤          CATEGORY:                         SITE CLASSIFICATION: ND            ¤
¤FED FACILITY DOCKET: F                                STATE PRP: N             ¤
¤    FED AGENCY PRP: N                             MUNICIPAL PRP: N             ¤
¤   S/I DIOXIN TIER:                                                            ¤
¤                                                                               ¤
¤  PROPOSED NPL UPDATE NO.: 00              FINAL NPL UPDATE NO.: 00            ¤
¤                                                                               ¤
àëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥
               Menu options               Forward                Leave      [M]
```

Incorrect should be 33°43'47"

Correct

```
èëëëëëëë VIEW ëëëëëëëëëëë£         SITE SUMMARY        èëëëëë SCREEN 1 OF 2 ëëëë£
¤                           àëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥                        ¤
¤           REF NO.: 05799                                EPA ID: GAD984305896  ¤
¤       IFMS ID NO.: 04TX                                                       ¤
¤              NAME: WESTSIDE DRIVE DRUM                                        ¤
¤            STREET: WESTSIDE DR. AT OLD WESTSIDE DR.                           ¤
¤              CITY: AUSTELL                                                    ¤
¤             STATE: GA                                ZIP CODE: 30001-         ¤
¤       COUNTY NAME: COBB                           COUNTY CODE: 067            ¤
¤  CONGRESS DISTRICT: 06                      FED FACILITY INDIC: N              ¤
¤   OWNER INDICATOR: UN                                RCRA FLAG:               ¤
¤          LATITUDE: 33 48 42.0                        LONGITUDE: 084 38 12.0   ¤
¤   LAT/LONG SOURCE: G                             INCIDENT TYPE:               ¤
¤   USGS HYDRO UNIT: 03130002                     METROSTAT AREA: 0520          ¤
¤  NPL STATUS INDIC: N                       COST RECOVERY INDIC: E             ¤
¤          CATEGORY:                         SITE CLASSIFICATION: ND            ¤
¤FED FACILITY DOCKET: F                                STATE PRP: N             ¤
¤    FED AGENCY PRP: N                             MUNICIPAL PRP: N             ¤
¤   S/I DIOXIN TIER:                                                            ¤
¤                                                                               ¤
¤  PROPOSED NPL UPDATE NO.: 00              FINAL NPL UPDATE NO.: 00            ¤
¤                                                                               ¤
àëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëëë¥
               Menu options               Forward                Leave      [M]
```

1430

Roberta Runge took samples 7/31 AM.

1 soil 6-8 water 2-4 wks turnaround time

GA EPD requesting EPA "take over site".

(Kent Howell GA DNR EPD) 656-6905

owner: [redacted] U.S. Plating & Bumper Service Inc.

[redacted] Milton Ave SE W. 627-5703

Atlanta 30315 A. (b)(6) Personal Privacy [redacted]

grants verbal approval of access to Roxen + Dixon 1438 7/31/93

to conduct investigation/survey

nickel, chrome, muriatic, rinses, cleaners

Fire Dept +/- 2,000 gpm - all night

— Richard Hindsman employee (b)(6) Personal Privacy [redacted]

3 nickel tanks → 20 years

- Field Expedient Notice ?? then PRP oversight

- Dun + Bradstreet? ~~Owner~~'s finances? assets?

insurance?

I contacted Mrs. Gage @ 1000 on 8/4. She said she contacted MKC Enterprises, M+J Solvents + Chemical Waste Management to come out + look at the site. They had not done so yet. She said she would have some info this week. I explained that the 1st 2 companies did not have cleanup capabilities to my knowledge. I gave her OHM's + Westinghouse's name. She ~~seems~~ appears clueless about the whole project.

RECEIVED
2 1993
ENVIRONMENTAL PROTECTION DIV
HAZARDOUS WASTE MGMT. BRANCH

1625 Mr ~~[illegible]~~ will contact me about
8/5 Cleaning up site. He is with
Conversion Technology
Will send me a closure plan

Sample Vat mat'l
soil samples.
ash/~~samples~~ Debris ~~sample~~

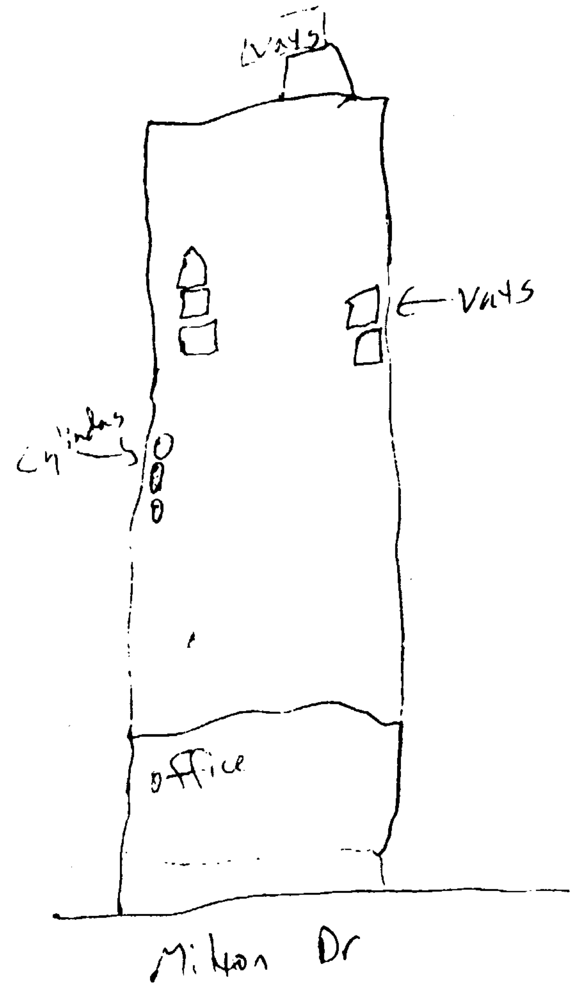
Drain area

TCLP metals,
2-3 weeks

10:00 Am arrival time

Bill Boss of Best Environmental
Services

Jerry Stafford of Chemical Waste
will arrive 8/5 afternoon Mgmt



Barry Fuller w/ [illegible]NS
Mel Johnson for AIG

REFERENCE # 15

Ser' 148, No. 7

Issued December 1958

Fulton County Georgia

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE

Soil Conservation Service

In cooperation with the

UNIVERSITY OF GEORGIA, COLLEGE OF AGRICULTURE

a point about 5 miles west of Alpharetta. Elevations at several places in the county are as follows: Alpharetta, 1,130 feet; Roswell, 1,072; College Park, 1,057; Atlanta, 1,050; Fairburn, 1,041; Stonewall, 1,024; and Ben Hill, 962.

The drainage system of the county is characterized by a dendritic drainage pattern. The pattern is well developed throughout the uplands, and surface drainage nearly everywhere is good to excessive. For much of Fulton County, drainage is into the Gulf of Mexico by way of the Chattahoochee and Little Rivers and tributaries of the Flint River. About 35 square miles, including the southern part of Atlanta and the adjacent area to the south, is drained eastward into the Atlantic Ocean by tributaries of the South River.

Most of the first bottoms of the Chattahoochee River are well drained, yet they are subject to overflow several times during the year. In many places along other streams, however, sediments recently washed from the surrounding uplands have filled the channels and altered drainage. As a result, many areas along small streams are swampy or semiswampy much of the year. In most places this altered drainage has not had sufficient time to change the characteristics of the soil profile, but some areas are too wet for cultivated crops.

Climate

The climate of Fulton County is humid and continental. The winters are mild, but they have very changeable temperature. The prevailing wind during winter is northerly. The weather is largely controlled by movement of areas of high and low barometric pressure and the accompanying winds. In winter these conditions cause frequent alternation of warm moist southerly winds and cold dry northerly winds (*7*). Data on normal monthly, seasonal, and annual temperature and precipitation at Atlanta are given in table 1.

The average winter temperature is 45.5° F. The temperature usually rises rapidly in March and April. The difference between the midwinter (January) average and that of midsummer (July) is 34.9°, which is relatively small compared with a difference of 60° in some of the more northern States. The summers are warm but are comparatively free from oppressive heat, because of the altitude and latitude of the county. The average summer temperature is 78.6°.

The average date of the last killing frost in spring is March 29, and that of the first in fall, November 8. The growing season therefore averages 224 days and is sufficient for the production of all the crops commonly grown. Fruit tree blossoms, especially peach blossoms, are occasionally damaged by late frost.

The winters are mild enough for the growing of fall-sown oats, wheat, rye, clover, and other crops for cover and grazing. Turnips, cabbage, kale, radishes, onions, rape, peas, and spinach can be planted late in fall or in December. Potatoes, beets, carrots, collards, and mustard can be planted in January and February, and other vegetables, during the latter part of March and the first part of April. Small grains and clover, if sown late on poorly drained soils, are damaged by

TABLE 1.—*Normal monthly, seasonal, and annual temperature and precipitation at Atlanta, Fulton County, Ga.*

[Elevation, 977 feet]

Month	Temperature [1]			Precipitation [2]			
	Average	Absolute maximum	Absolute minimum	Average	Driest year (1954)	Wettest year (1948)	Ave age sno fal
	° F.	° F.	° F.	*Inches*	*Inches*	*Inches*	*Inch*
December	45.2	73	1	4.55	3.00	4.11	0
January	44.6	76	−2	4.67	3.73	3.47	1
February	46.7	78	−8	4.82	2.70	6.20	
Winter	45.5	78	−8	14.04	9.43	13.78	2
March	52.7	87	8	5.67	3.07	10.19	
April	61.7	93	25	4.42	1.91	2.82	
May	70.0	97	38	3.82	3.31	7.83	0
Spring	61.5	97	8	13.91	8.29	20.84	
June	77.7	100	39	4.02	2.08	1.32	0
July	79.5	103	58	4.41	6.31	11.26	0
August	78.6	100	55	3.81	1.14	4.20	0
Summer	78.6	103	39	12.24	9.53	16.78	0
September	74.4	102	43	2.96	.26	3.60	0
October	63.4	94	28	2.60	.17	.73	([3])
November	51.9	82	14	3.41	4.12	15.72	
Fall	63.2	102	14	8.97	4.55	20.05	
Year	62.2	103	−8	49.16	31.80	71.45	2

[1] Average temperature based on 21-year record, through 1955; hig est and lowest temperatures on a 52-year record, 1879-1930.

[2] Average precipitation based on a 21-year record, through 19 wettest and driest years based on a 90-year record, 1859-1955; sno fall, based on a 41-year record through 1930.

[3] Trace.

the heaving produced by alternate freezing and thaw ing. Damage to these crops rarely occurs on the bett drained sandy soils.

The length of the grazing period depends on th kinds of pasture plants sown and on the amount fertilizer used. The grazing period for pasture co sisting of bermudagrass, broomsedge, crabgrass, com mon lespedeza, and weeds extends from the latter pa of March to the latter part of October. This peri can be lengthened by use of proper fertilizers and b seeding with clovers, coastal bermudagrass, tall fescu orchardgrass, and ryegrass. Permanent pasture shou be supplemented with temporary pasture during d spells and winter.

Rainfall varies somewhat from year to year, but i seasonal distribution is generally favorable for crop Serious drought is not likely to occur more than on in 10 to 15 years. Wet weather sometimes damag hay during the curing process and small grain harvesttime. During heavy rains, corn is occasio ally drowned out on poorly and somewhat drained soils of first bottoms, and in this k weather cotton develops excess foliage and is mo

REFERENCE # 10

RCE . Environmental Science Services Administration . Environmental Data Service

U.S. DEPARTMENT OF COMMERCE
C. R. Smith, Secretary

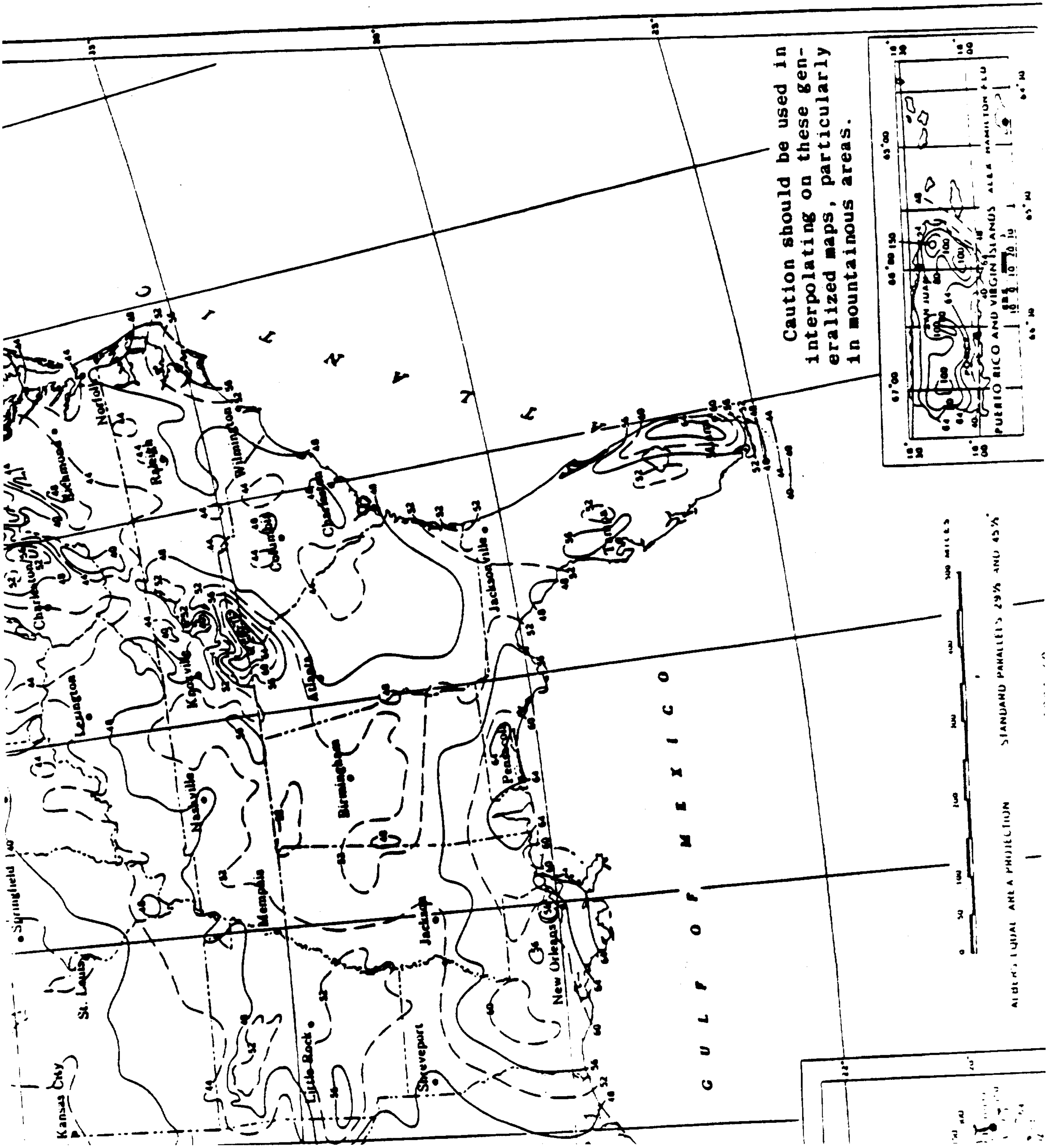
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
Robert M. White, Administrator

ENVIRONMENTAL DATA SERVICE
Woodrow C. Jacobs, Director

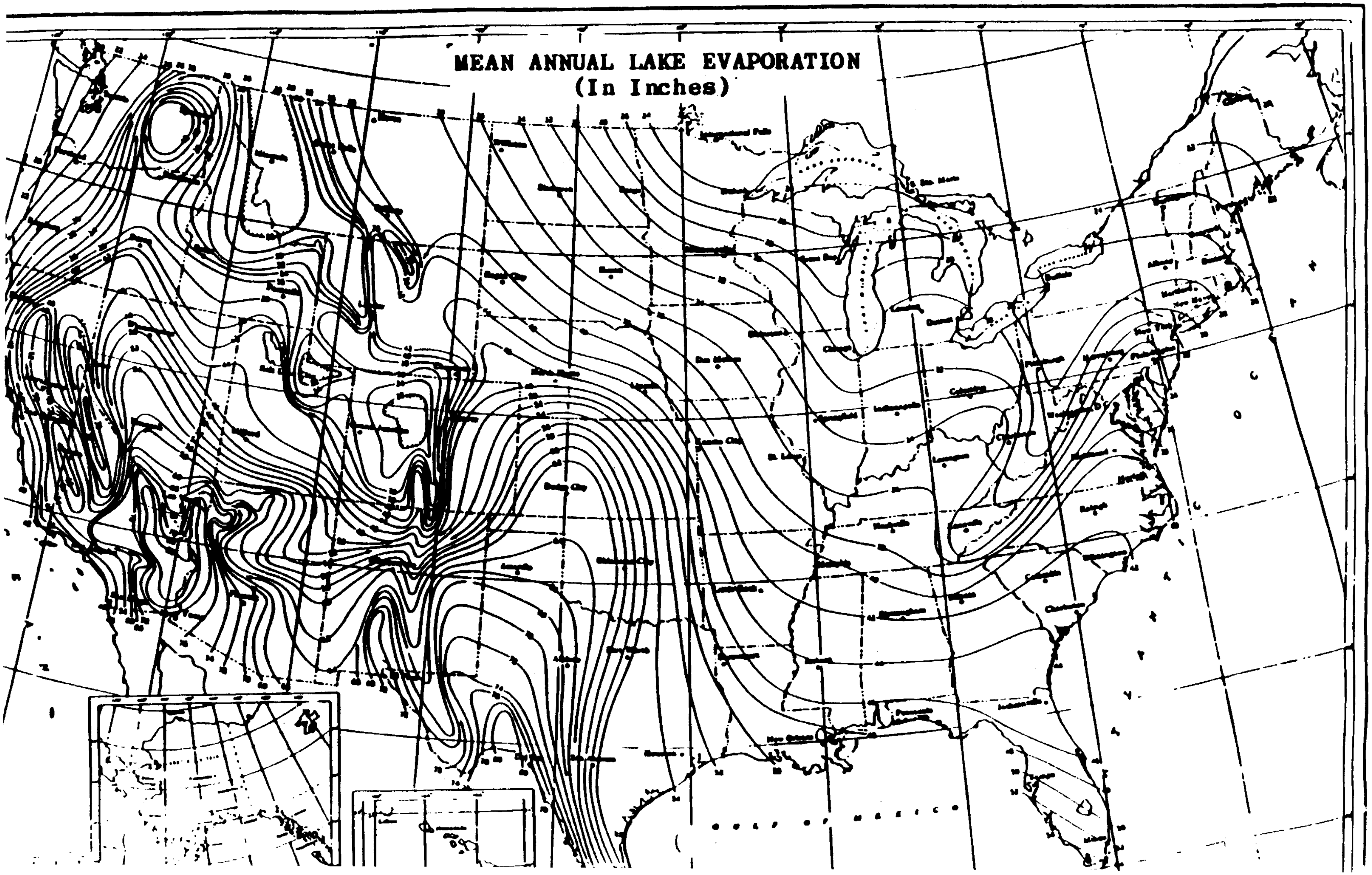
JUNE 1968

REPRINTED BY THE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
1983

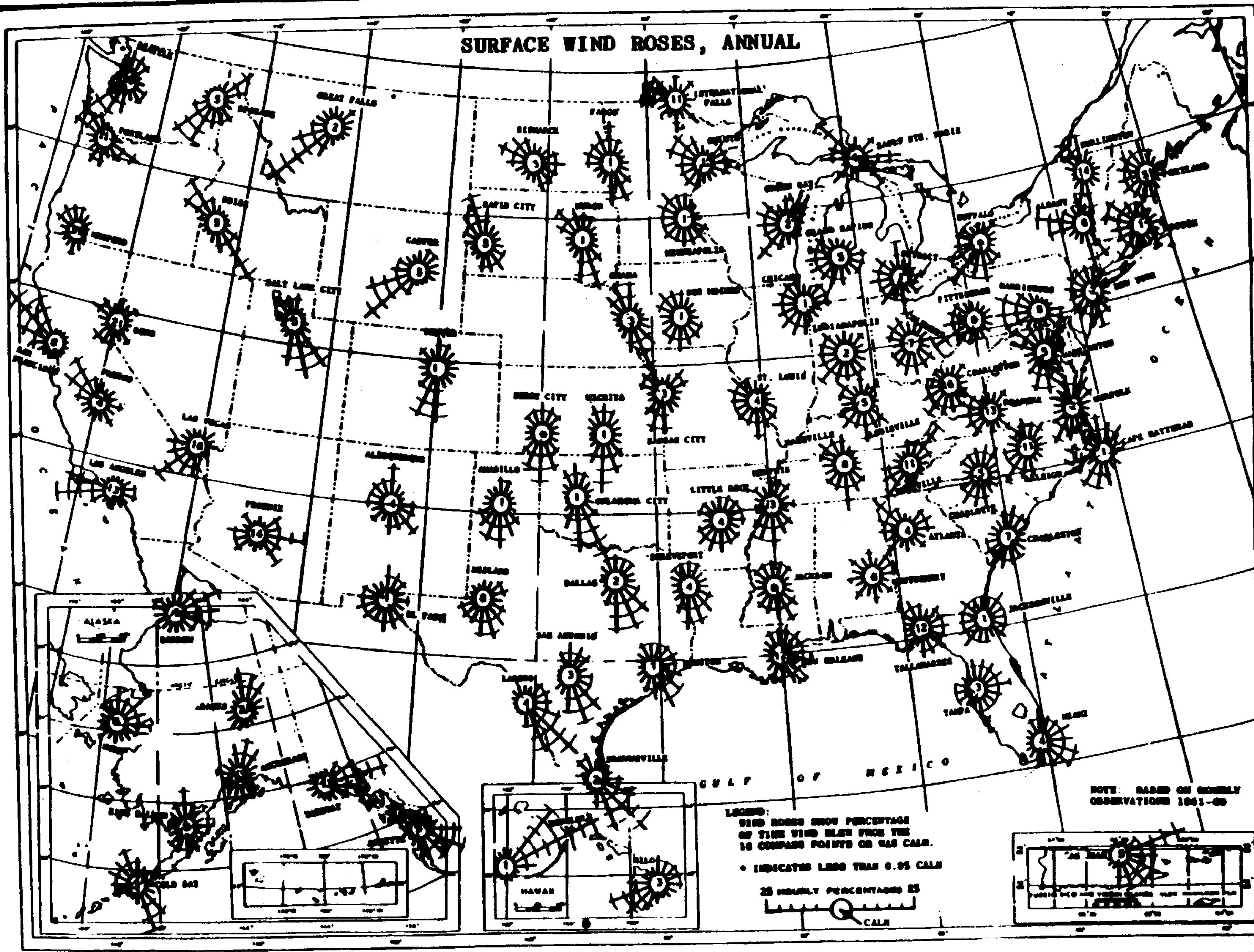
Annual Rainfall



E EVAPORATION



SURFACE WINIC ROSES, MONTHLY AND ANNUAL· RESUL:



P. 76

DEPARTMENT OF COMMERCE
[illegible] H. Hodges, Secretary

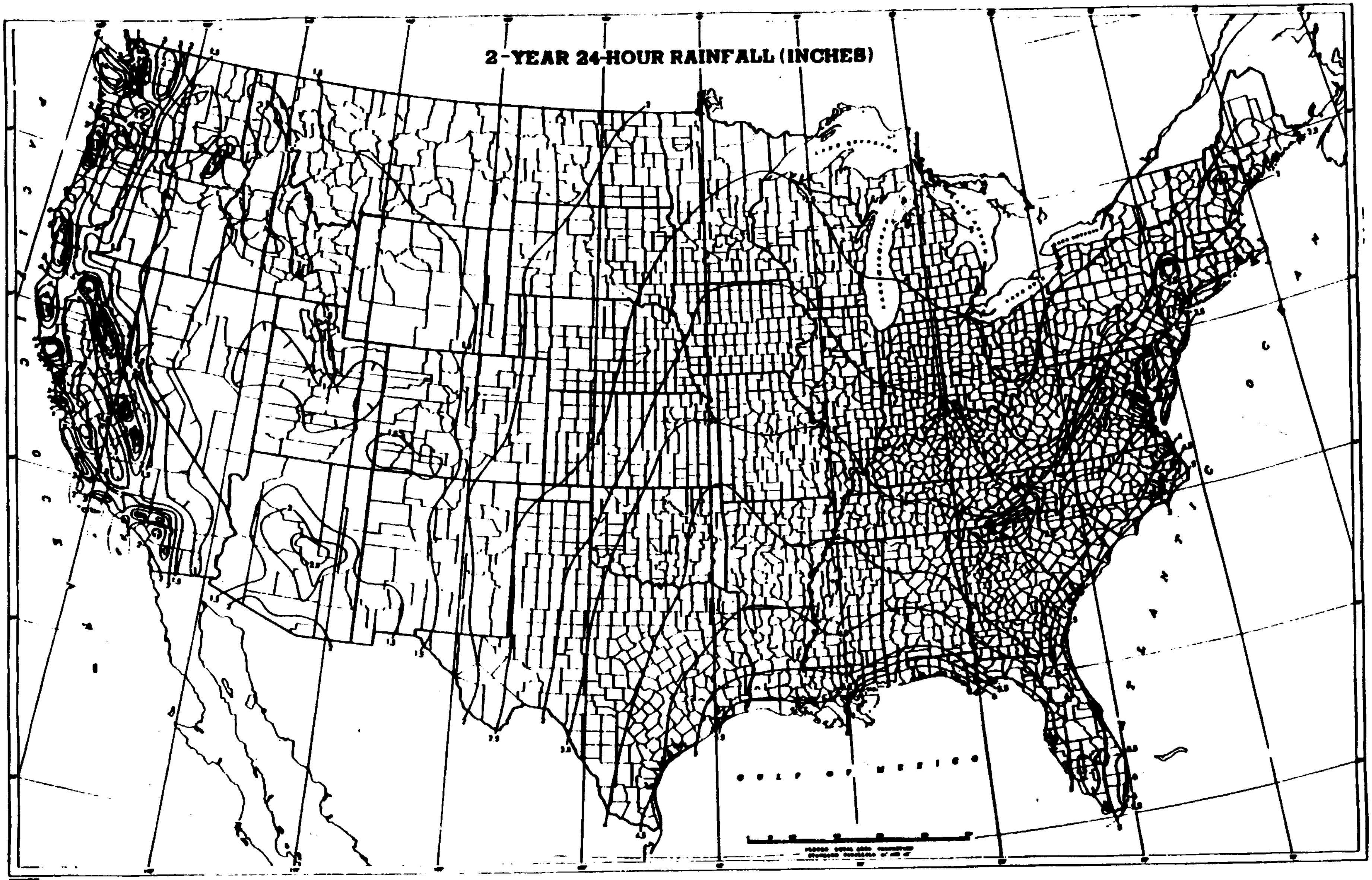
WEATHER BUREAU
F. W. Reichelderfer, Chief

TECHNICAL PAPER NO. 40

RAINFALL FREQUENCY ATLAS OF THE UNITED STATES

for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years

Prepared by
DAVID M. HERSHFIELD
Cooperative Studies Section, Hydrologic Services Division
for
Engineering Division, Soil Conservation Service
U.S. Department of Agriculture

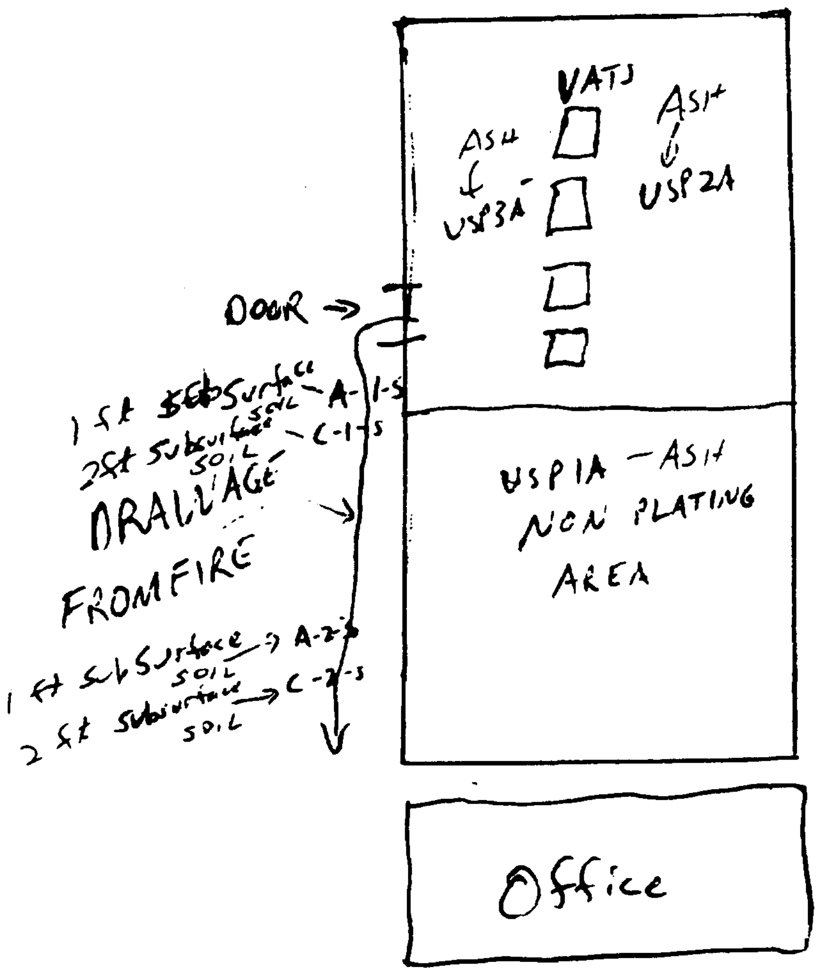

2-YEAR 24-HOUR RAINFALL (INCHES)
GULF OF MEXICO

Bumper Distribution Of Atlanta

Preliminary Assessment

RECEIVED
1 2 1993
ENVIRONMENTAL PROTECTION DIV
HAZARDOUS WASTE MGMT BRANCH

U S Plating



93/..

PHONE: # 627-5703
OWNER: JEANETTE GAGE

1 3

THURSDAY AUGUST 6, 1992

1030 TAT Rinquist and Ryland on site
U.S. Plating, 73 Milton Ave.
OSC Charlie Stevens
According to Mr. Cunningham: plant supervisor; plating line in tact; vats and lines re-usable; no cyanide involved; DISCUSSION HELD W/ PRP AND CONTRACTOR (CONVERSION TECHNOLOGY) PINI H. HAROZ / STUART MICHELS (reps)
CONDITIONS OF BLDG. DISCUSSED
INSTRUMENTS Barium, CHROME, NICKEL (Metals involved)
HCl, Acid salts, Caustic (cleaner (proprietary) soap)
Sulfuric Acid mixed w/ water; Hydrogen Peroxide
BUSINESS WANTS TO - REBUILD; DRUM LIQUIDS
REPAIR PLATING LINE; REMOVE DEBRIS; DIKE RUNOFF
LABEL ALL CHEMICALS, STAGE IN CLEAN AREA BY COMPATABILITY;
WASTE STREAMS: 3 PILES (ROLL-OFFS)

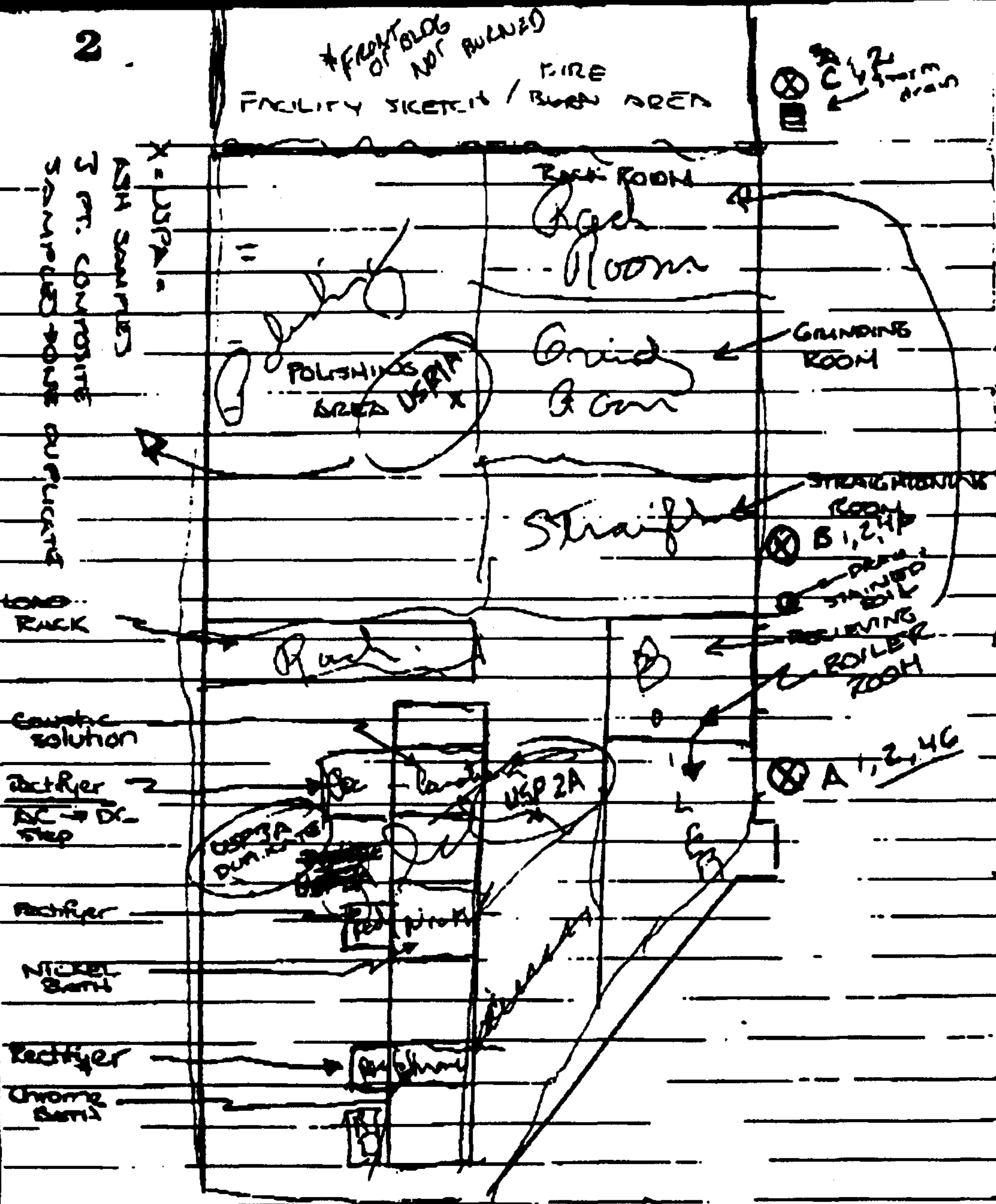
1. CLEAN DEBRIS
2. ? DEBRIS
3. HAZ DEBRIS
4. SOIL CONTAMINATED BY RUNOFF
5. DRUM BY DRUM INVENTORY

PHASE I - STEEL
PHASE II - ASH SAMPLES /
PHASE III - REMOVAL CONTRACTOR
A. OSH - AIR MONITORING
B. LIQUIDS - DRUMED
C. SOIL - SAMPLED / EXCAVATED
D. CONFIRMATION SAMPLING
E. REBUILD

1300 AGREED THAT (CTI) DEVELOP SCOPE OF WORK. NOTIFY EPA / TAT OF FUTURE ACTIONS

N
7, 92
INS
OOD.
ON
WAS
SAMPLING
MICHELS
ollecting
SAMPLE
- 2
ETALS toll
THE DAY
I IN
→ TAT
AMPLES
I WOULD
TER
OSC

2



1530

1630

164

1310 TAT, OSC DEPART SITE 178

18

GRABS NOT USED

⊗ SOIL SAMPLE

SAMPLES COLLECTED @ 1,2,4,6 @ pts A&B

TAT COLLECTED SPLIT @ C-1

⊗ C 1, 2 storm drain

Aug 6, 92 → 9 ash samples
Aug 7, 92 → 8 → 4 BRL
FRIDAY, AUGUST 7, 1992

1530 TAT RINGWALL ON SITE CONVERSION TECHNOLOGY INC. HAS TAKEN (9) ASH SAMPLES ON AUG 6, 92 AND (8 soil) AUG 7, 92 WITHOUT NOTIFYING EPA OSC STEVENS AS WAS BELIEVED TO BE UNDERSTOOD. TAT SPOKE W/ STUART MICHLES ON SITE AND EXPLAINED THAT EPA WAS TO BE NOTIFIED OF ANY FURTHER SAMPLING ACTIVITY →

1630 CTI PROJECT MANAGER STUART MICHELS COLLECTING SAMPLE @ C-2 Root

1645 CTI Project Manager Stuart Michels collecting 1 FOOT & 2 FOOT SAMPLES FOR TAT @ SAMPLE PT. A → A-1, A-2 // C-1, C-2 WILL BE ANALYZED BY TAT FOR METALS & pH A-1 & A-2 → WERE COLLECTED EARLIER IN THE DAY Mr. MICHELS COLLECTED RESAMPLE FOR TAT IN EFFORT TO SAVE U.S. PLATING MONEY → TAT EXPLAINED TO CTI REP. THAT ASH SAMPLES WOULD ALSO BE REQUIRED AND THEY WOULD BE COLLECTED BY TAT ON 8/10/92 AFTER CONSULTATION BETWEEN TAT & EPA OSC

1730 TAT RINGWALL DEPTS SITE

1800 End of day

GRINDING ROOM

STRAIGHTENING ROOM

⊗ B 1, 2, 4

DRUMS

STAINED SOIL

PEELING

BOILER ROOM

⊗ A 1, 2, 4, 6

NOT USED

SAMPLE @ pts A & B

4

	TIME
MONDAY August 10, 1992	1510
weather: clear and sunny expected high 90°F	1515
0915 TAT Ringwall on site, over weekend	1530
Mr Cunningham has cut steel structural	1530
debris and removed from building all	
scrap steel is to be removed from site	
by Mendis recycling - Mr Cunningham	
has further made repeated entries into	
the baghouse in level D w/ a dust mask	1600
operating a bobcat to move the steel	1630
and stockpiling of ash enough	
to allow access to retrieve the steel.	
concern is that no particulate air	0730
monitoring is being used and	1000
Mr Cunningham is not properly protected	1400
or 24 hr OSHA trained for work on a	
hazardous waste site - TAT called	
OSC Stevens and notified him of	
the aforementioned - OSC Stevens told	
TAT he was en-route to site.	
1000 OSC Stevens on site, outline of EPA	
concerns explained to Mr Cunningham	
POINT MADE That U.S. Plating needs	
to allow CTI to due there job. Mr Rui	
Haroz is due to be back on site at 1300	
NOTE: Need Lab for 4 soil, 3 ash - Metals & pH	
1 week turn around - 1 ash duplicate	
to go to ESD, Athens - TCLP Metals - 8RCRA & BAH isotopes	
1100 OFF SITE	
1500 TAT RINGWALL & GRIER ON SITE, TAT TO	
COLLECT 3 ASH SAMPLES - 1 DUPLICATE	
TOTAL 4 JARS -	

TIME	SAMPLE #	MEDIA	COLLECT PT.
1510	USP1A	ASH	ASH FROM FIRE
1515	USP2A	ASH	PLATING LINE ASH FROM FIRE
1530	USP3A	ASH	PLATING LINE ASH FROM FIRE
1530	USP3A (DUPLICATE)		

- SAMPLES USP1A, USP2A, USP3A, C-1-S, C-2-S A-1-S, A-2-S TO BE ANALYZED FOR TCLP Metals, Total Cr, Ni, pH - (contract lab)
- USP3A Duplicate same analysis ESD Athens

1600 TATs off site

1630 End of day

TUESDAY AUGUST 11, 1992

0730 Beg / Tag samples for shippment

1000 Sample to ESD shipped

1600 Samples shipped to Lab (contract)

d high 90°F
weekend
l structural
lding all
from site
iaphons
tries into
dust mask
steel
h enough
the steel.
ulate air
l and
protected
ork on a
called
instead of
tevens told
to
of EPA
aiaphans
say needs
Mr Pini
at 1800
etals & pH
duplicate
CRA / PSA
tals - instruments

TE, TAT TO
DUPLICATE

Conversion Technology inc.
ENVIRONMENTAL CONSULTING ENGINEERS

August 28, 1992

Mr. Charlie Stevens
Environmental Protection Agency
ERRB
345 Courtland Street, NE
Atlanta, GA 30365

Dear Mr. Stevens:

Enclosed is a copy of the report entitled "Assessment of the Ash at U.S. Plating and Bumper Service".

The sample results, which are summarized in Table 1 of the report, indicate that the ash is not hazardous.

If you have any questions, please do not hesitate to call me at (404) 263-6330.

Sincerely yours,

P. Haroz

Pini H. Haroz
Director, Engineering

PHH:tsk

Enclosures: 1 report

Home Office: 3300 Holcomb Bridge Rd., Suite 250 • Norcross, GA. 30092 • 404/263-6330 • Fax: 404/263-8348

ASSESSMENT OF THE ASH AT
U.S. PLATING & BUMPER SERVICE

PREPARED FOR:

U.S. PLATING & BUMPER SERVICE

78 MILTON AVENUE, S.E.

ATLANTA, GA 30315

(404) 627-5703

PREPARED BY:

Conversion Technology inc.
ENVIRONMENTAL CONSULTING ENGINEERS

3300 Holcomb Bridge Rd., Suite 250
Norcross, Georgia 30092
Phone (404) 263-6330
Fax (404) 263-8348

AUGUST 18, 1992

ASSESSMENT OF THE ASH AT
U.S. PLATING & BUMPER SERVICE

PREPARED FOR:

U.S. PLATING & BUMPER SERVICE

78 MILTON AVENUE, S.E.

ATLANTA, GA 30315

(404) 627-5703

PREPARED BY:

CONVERSION TECHNOLOGY, INC.

3300 HOLCOMB BRIDGE ROAD, SUITE 250

NORCROSS, GEORGIA 30092

(404) 263-6330

AUGUST 18, 1992

1. BACKGROUND

On July 30, 1992, a fire burned the production area at U.S. Plating & Bumper Service located at 78 Milton Avenue, S.E., Atlanta, Georgia 30315.

In the production area, there are plating vats containing plating liquids with concentrations of heavy metals and rinse water.

A visual inspection of the facility, after the fire, revealed that all the liquid in the vats seemed in-place.

2. SCOPE OF WORK

Conversion Technology, Inc. (CTI) was contracted by U.S. Plating & Bumper Service to determine whether or not the ash in the facility was hazardous waste.

3. SITE TESTING

Ash samples were taken at locations shown in the enclosed drawing. The locations were determined in reference to different processes in the facility and the discoloration of the ash.

4. RESULTS

The results are summarized in Table 1 and the Laboratory Analysis reports are enclosed.

The sample results indicate that the ash is not hazardous and could be handled as any other non-hazardous ash.

TABLE 1: ASH SAMPLE RESULTS

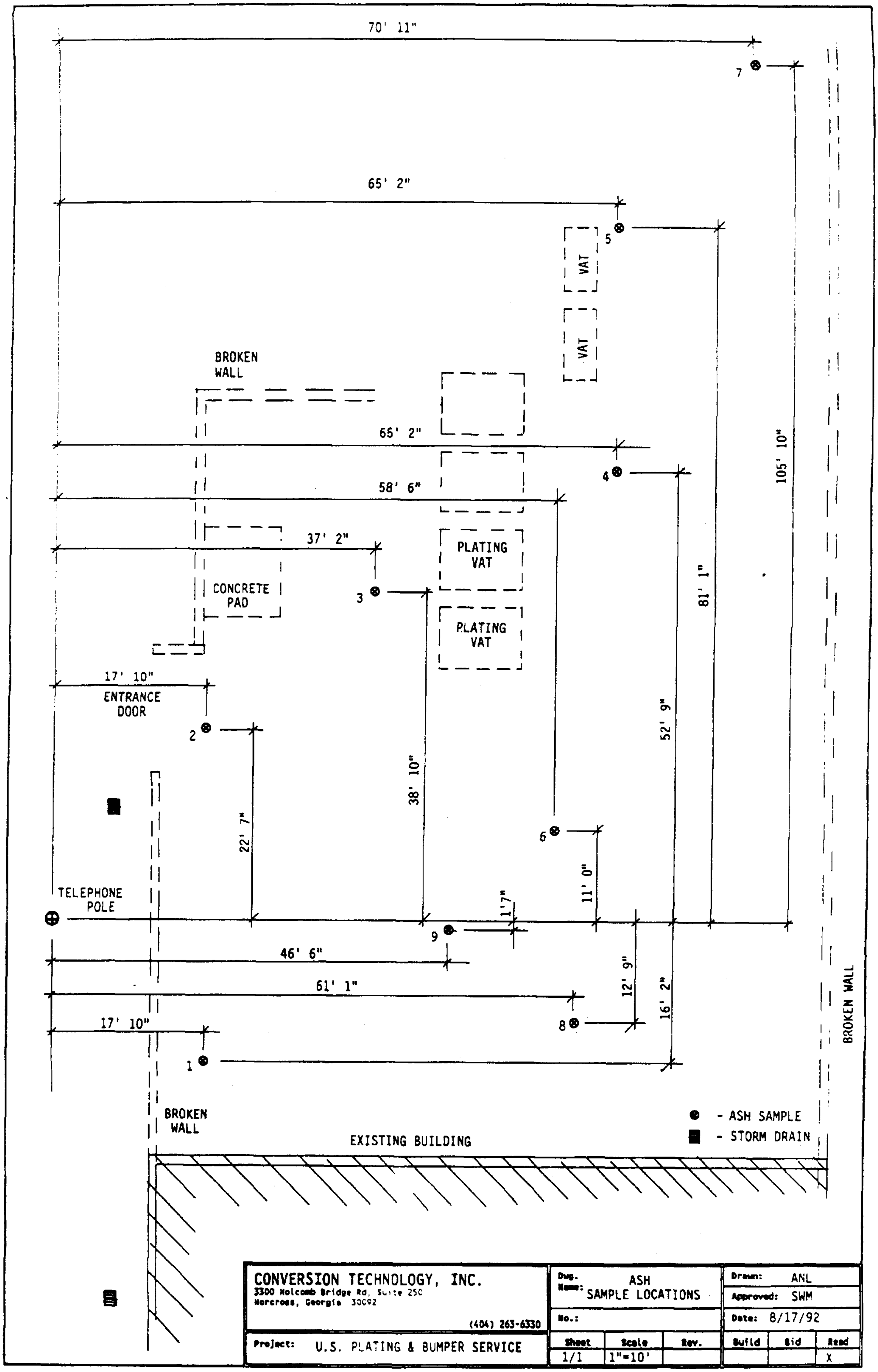
PARAMETER	REGUL. LIMIT	LOCATIONS (SEE DRAWING)								
		1	2	3	4	5	6	7	8	9
pH (lab.)	-----	11.2	9.85	12.2	10.7	10.1	9.49	8.84	10.1	10.8
Arsenic (As) mg/l	5.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Barium (Ba) mg/l	100.0	7.4	0.2	0.16	0.14	BDL	0.43	0.18	0.69	0.50
Cadmium (Cd) mg/l	1.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Chromium (Cr) mg/l	5.0	BDL	BDL	0.06	0.19	0.49	BDL	BDL	BDL	0.02
Lead (Pb) mg/l	5.0	BDL	BDL	0.04	BDL	BDL	BDL	BDL	BDL	BDL
Mercury (Hg) mg/l	0.2	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Selenium (Se) mg/l	1.0	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Silver (Ag) mg/l	5.0	0.14	BDL	0.06	BDL	0.28	0.02	0.03	BDL	0.01

BDL - Below Detection Limit

5. RECOMMENDATIONS

5.1 Even though the ash is not hazardous waste, the cleaning and removal of debris should be conducted in a safe manner and in compliance with OSHA regulations.

5.2 Before the ash is disposed, it is recommended that it will be tested and then disposed properly.


70' 11"
7
65' 2"
5
VAT
VAT
BROKEN
WALL
65' 2"
4
58' 6"
37' 2"
PLATING
VAT
CONCRETE
PAD
3
PLATING
VAT
105' 10"
81' 1"
17' 10"
ENTRANCE
DOOR
2
52' 9"
38' 10"
22' 7"
6
11' 0"
TELEPHONE
POLE
1'7"
9
46' 6"
61' 1"
12' 9"
16' 2"
17' 10"
8
1
BROKEN WALL
BROKEN
WALL
- ASH SAMPLE
- STORM DRAIN
EXISTING BUILDING
CONVERSION TECHNOLOGY, INC.
3300 Holcomb Bridge Rd, Suite 250
Norcross, Georgia 30092
(404) 263-6330
Dwg. Name: ASH SAMPLE LOCATIONS
No.:
Drawn: ANL
Approved: SWM
Date: 8/17/92
Project: U.S. PLATING & BUMPER SERVICE
Sheet 1/1
Scale 1"=10'
Rev.
Build
Bid
Read X

LABORATORY REPORTS

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-1

Sample: Ash, USP1, #1, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	11.2	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	7.4	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	BDL	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	0.14	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dier

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-2

Sample: Ash, USP1, #2, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	9.85	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.2	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	BDL	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	BDL	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dixon

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-3

Sample: Ash, USP1, #3, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory) (EPA 9045)	12.2	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.16	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	0.06	0.01	5.0
D008	Lead (Pb).....................	0.04	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	0.06	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dier

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-4

Sample: Ash, USP1, #4, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	10.7	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.14	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	0.19	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	BDL	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dia

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-5

Sample: Ash, USP1, #5, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	10.1	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	BDL	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	0.49	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	0.28	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dun

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-6

Sample: Ash, USP1, #6, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)	9.49	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)	BDL	2.5	5.0
D005	Barium (Ba)	0.43	0.1	100.0
D006	Cadmium (Cd)	BDL	0.01	1.0
D007	Chromium (Cr)	BDL	0.01	5.0
D008	Lead (Pb)	BDL	0.1	5.0
D009	Mercury (Hg)	BDL	0.0005	0.2
D010	Selenium (Se)	BDL	0.5	1.0
D011	Silver (Ag)	0.02	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise S. Dun

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-7

Sample: Ash, USP1, #7, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)	8.84	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)	BDL	2.5	5.0
D005	Barium (Ba)	0.18	0.1	100.0
D006	Cadmium (Cd)	BDL	0.01	1.0
D007	Chromium (Cr)	BDL	0.01	5.0
D008	Lead (Pb)	BDL	0.1	5.0
D009	Mercury (Hg)	BDL	0.0005	0.2
D010	Selenium (Se)	BDL	0.5	1.0
D011	Silver (Ag)	0.03	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise S. Dein

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-8

Sample: Ash, USP1, #8, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045).....................	10.1	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.69	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	BDL	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	BDL	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dein

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-9

Sample: Ash, USP1, #9, In the Plant, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	10.8	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.50	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	0.02	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	0.01	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dien

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-10

Sample: Soil, USP1, A-6, Outside the Wall, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)	5.00	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)	BDL	2.5	5.0
D005	Barium (Ba)	0.77	0.1	100.0
D006	Cadmium (Cd)	BDL	0.01	1.0
D007	Chromium (Cr)	0.16	0.01	5.0
D008	Lead (Pb)	BDL	0.1	5.0
D009	Mercury (Hg)	BDL	0.0005	0.2
D010	Selenium (Se)	BDL	0.5	1.0
D011	Silver (Ag)	0.02	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Teir

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-11

Sample: Soil, USP1, B-6, Outside the Wall, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)....................	4.87	-

The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)..................	BDL	2.5	5.0
D005	Barium (Ba)...................	0.14	0.1	100.0
D006	Cadmium (Cd)..................	BDL	0.01	1.0
D007	Chromium (Cr).................	0.95	0.01	5.0
D008	Lead (Pb).....................	BDL	0.1	5.0
D009	Mercury (Hg)..................	BDL	0.0005	0.2
D010	Selenium (Se).................	BDL	0.5	1.0
D011	Silver (Ag)...................	BDL	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise A. Dier

ASI

ANALYTICAL SERVICES, INC.

ENVIRONMENTAL MONITORING & LABORATORY ANALYSIS
390 TRABERT AVENUE ● ATLANTA, GEORGIA 30309 ● (404) 892-8144
FAX (404)892-2740 ● Federal I.D. #58-1625655

LABORATORY REPORT

Conversion Technology Inc.
3300 Holcomb Bridge Road
Suite 250
Norcross, GA 30092

August 14, 1992

Attention: Mr. Pini Haroz

Report No. 36738-12

Sample: Soil, USP1, C-2, Outside the Wall, received 8/7/92

RESULTS

	Result	Detection Limit
pH (laboratory)(EPA 9045)	9.07	-

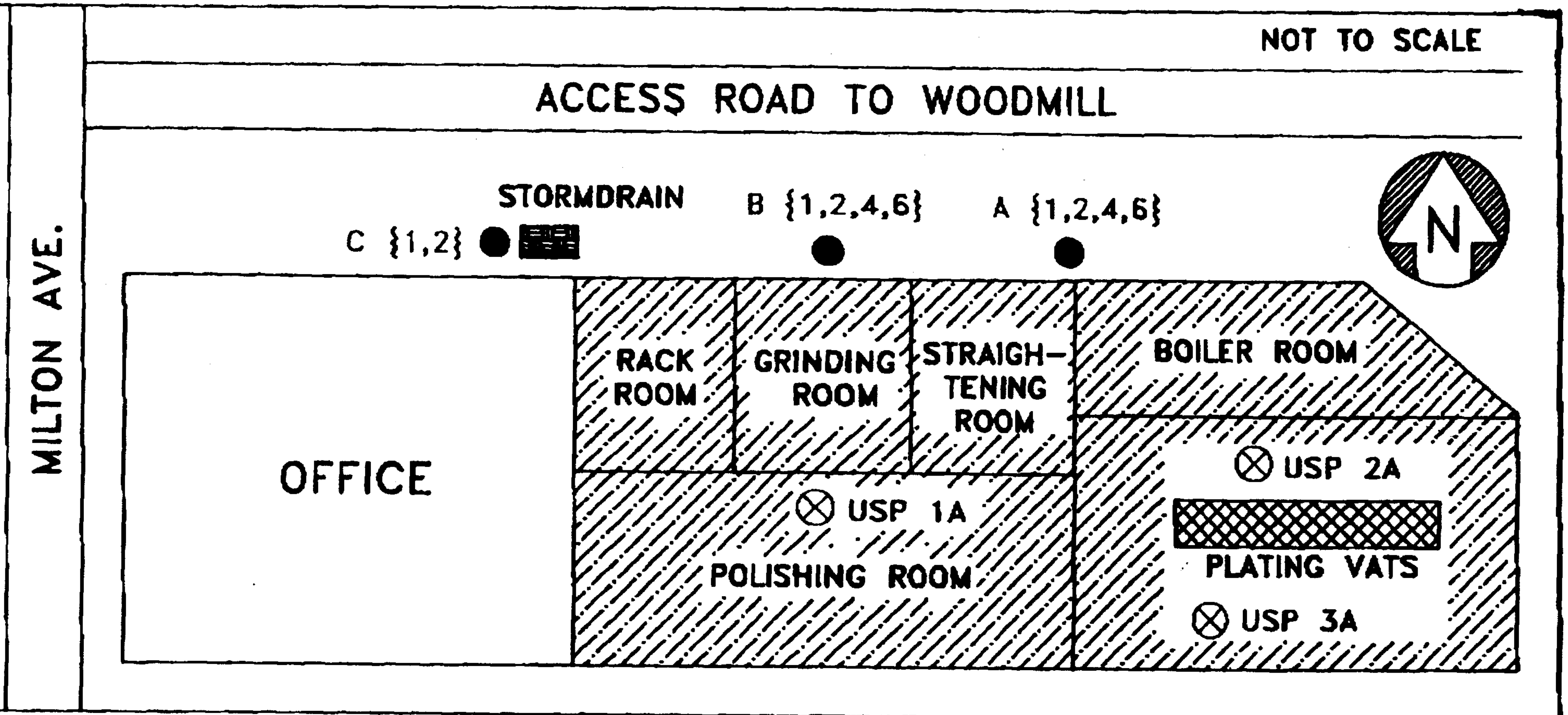
The sample was extracted and analyzed according to the procedures outlined in the TCLP Method 1311 promulgated as Appendix II, 55 FR 11862, March 29, 1990 (revised June 29, 1990). The results of the analysis are as follows:

EPA HW Number	Parameter	Result (mg/l)	Detection Limit (mg/l)	Regulatory Limit (mg/l)
D004	Arsenic (As)	BDL	2.5	5.0
D005	Barium (Ba)	3.4	0.1	100.0
D006	Cadmium (Cd)	BDL	0.01	1.0
D007	Chromium (Cr)	0.10	0.01	5.0
D008	Lead (Pb)	BDL	0.1	5.0
D009	Mercury (Hg)	BDL	0.0005	0.2
D010	Selenium (Se)	BDL	0.5	1.0
D011	Silver (Ag)	0.01	0.01	5.0

BDL = Below Detection Limit

Respectfully submitted,

By: Denise S. Deier



U.S. PLATING SITE

ATLANTA, FULTON COUNTY, GEORGIA

TDD# 04-9208-0005

SITE DIAGRAM/SAMPLING LOCATION MAP

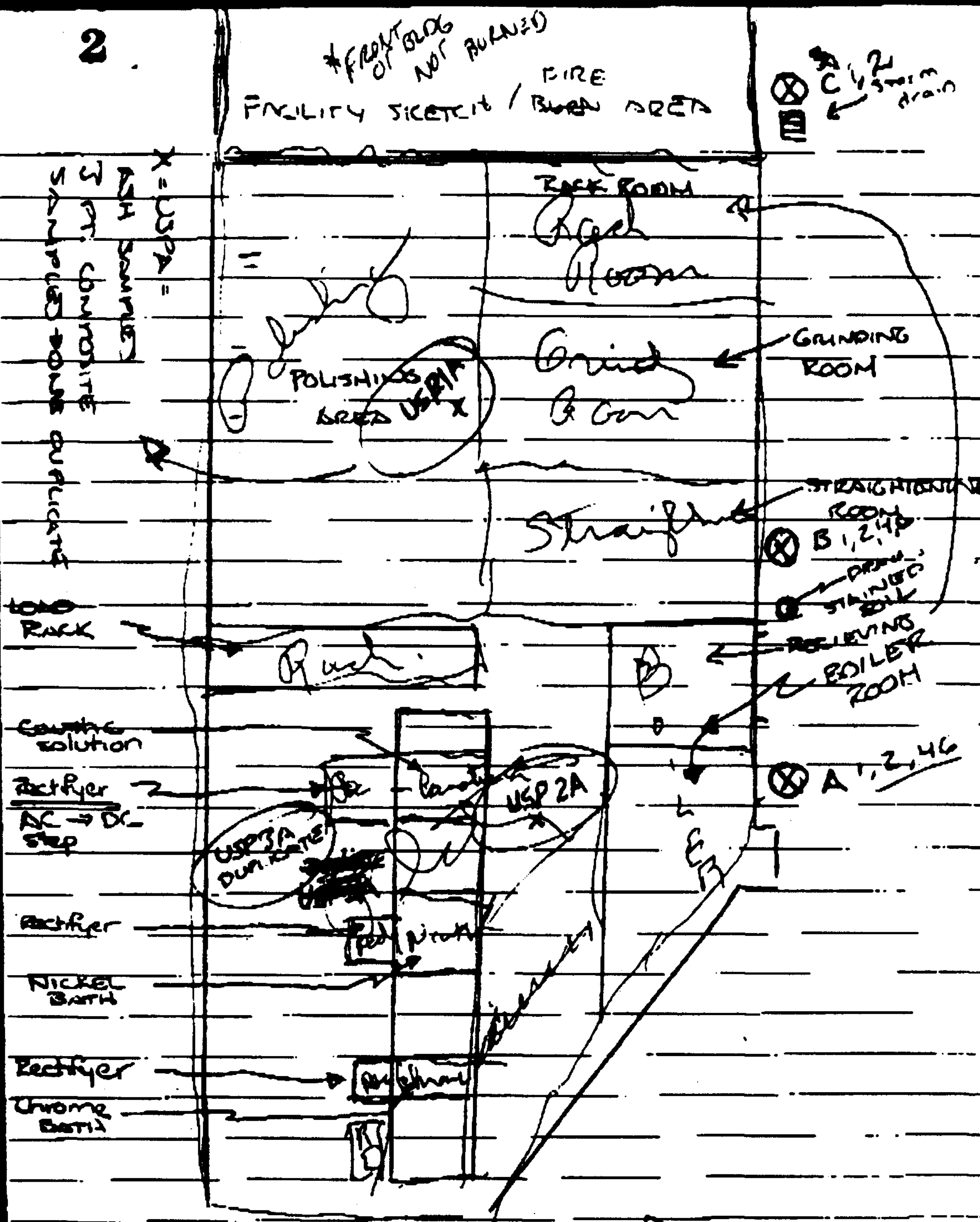
LEGEND

● SOIL SAMPLE (GRAB) [C-1,C-2;A-1,A-2: SPLITS WITH PRP]

⊗ ASH SAMPLE COMPOSITE

BURNED AREA

2



1310 TATs, OSC DEPART SITE

NOT USED

⊗ SOIL SAMPLE

SAMPLES COLLECTED @ 1, 2, 4, 6 @ pts A&B

TAT COLLECTED SPLIT @ C-1

C 1,2 storm drain

GRINDING ROOM

STRAIGHTENING ROOM

B 1,2,4

STAINED SOIL

RELIEVING

BOILER ROOM

A 1,2,4

Aug 6, 92 → 9 ash samples
Aug 7, 92 → 8 → 4 ppl
FRIDAY, AUGUST ~~7~~ 8, 1992
1530 TAT RINGWALL ON SITE CONVERSION TECHNOLOGY INC. HAS TAKEN (9) ASH 8 SOIL SAMPLES ON AUG 6, 92 AND AUG 7, 92 WITHOUT NOTIFYING EPA OSC STEVENS AS WAS BELIEVED TO BE UNDERSTOOD. TAT SPOKE W/ STUART MICHLES ON SITE AND EXPLAINED THAT EPA WAS TO BE NOTIFIED OF ANY FURTHER SAMPLING ACTIVITY →
1630 CTI PROJECT MANAGER ~~[illegible]~~ STUART MICHELS COLLECTING SAMPLE @ C-2 foot
1645 CTI Project Manager Stuart Michels collecting 1 FOOT & 2 FOOT SAMPLES FOR TAT @ SAMPLE PT. A → A-1, A-2 // C-1, C-2 WILL BE ANALYZED BY TAT FOR METALS + pH A-1 & A-2 → WERE COLLECTED EARLIER IN THE DAY Mr. MICHELS COLLECTED RESAMPLE FOR TAT IN EFFORT TO SAVE U.S. PLATING MONEY → TAT EXPLAINED TO CTI REP. THAT ASH SAMPLES WOULD ALSO BE REQUIRED AND THEY WOULD BE COLLECTED BY TAT ON 8/10/92 AFTER CONSULTATION BETWEEN TAT & EPA OSC
1730 TAT RINGWALL DEPTS SITE
1800 End of day

NOT USED

SAMPLE @ pts A & B

Hall

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV
COLLEGE STATION RD.
ATHENS, GA. 30613

RECEIVED
2 1993
ENVIRONMENTAL PROTECTION DIV
HAZARDOUS WASTE MGMT. BRANCH

*****MEMORANDUM******

DATE: 09/16/92

SUBJECT: Results of TCLP Analysis;
92-0798 U.S. PLATING
ATLANTA GA

FROM: Mike Wasko, Chemist Michael Wasko

TO: BILL BOKEY

THRU: William H. McDaniel
Chief, Inorganic Chemistry Section

Attached are the results of analysis of samples collected as part of the subject project.

If you have any questions please contact me.

ATTACHMENT

RECEIVED
SEP 16 1992

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV
COLLEGE STATION RD.
ATHENS, GA. 30613

*****MEMORANDUM******

DATE: 08/20/92

SUBJECT: Results of Specified Analysis;
92-0798 U.S. PLATING
ATLANTA GA

Michael Wasko for
FROM: William H. McDaniel

TO: BILL BOKEY

Attached are the results of analysis of samples collected as part of the subject project.

If you have any questions please contact me.

ATTACHMENT

SAMPLE AND ANALYSIS MANAGEMENT SYSTEM
EPA-REGION IV ESD, ATHENS, GA.

08/19/92

SPECIFIED ANALYSIS DATA REPORT

PROJECT NO. 92-0798 SAMPLE NO. 70926 SAMPLE TYPE: ASH PROG ELEM: SSF COLLECTED BY: J RINGWALL
SOURCE: U.S. PLATING CITY: ATLANTA ST: GA
STATION ID: USP3A SURFACE ASH PLATING FACILITY FIRE COLLECTION START: 08/10/92 1530 STOP: 00/00/00

RESULTS	UNITS	PARAMETER
9.98		PH(LABORATORY)

FOOTNOTES
*A-AVERAGE VALUE *NA-NOT ANALYZED *NAI-INTERFERENCES *J-ESTIMATED VALUE *N-PRESUMPTIVE EVIDENCE OF PRESENCE OF MATERIAL
*K-ACTUAL VALUE IS KNOWN TO BE LESS THAN VALUE GIVEN *L-ACTUAL VALUE IS KNOWN TO BE GREATER THAN VALUE GIVEN
*U-MATERIAL WAS ANALYZED FOR BUT NOT DETECTED. THE NUMBER IS THE MINIMUM QUANTITATION LIMIT.

SAMPLE AND ANALYSIS MANAGEMENT SYSTEM
EPA-REGION IV ESD, ATHENS, GA.

09/16/92

METALS DATA REPORT

PROJECT NO. 92-0798 SAMPLE NO. 70926 SAMPLE TYPE: ASH PROG ELEM: SSF COLLECTED BY: J RINGWALL
SOURCE: U.S. PLATING CITY: ATLANTA ST: GA
STATION ID: USP3A SURFACE ASH PLATING FACILITY FIRE COLLECTION START: 08/10/92 1530 STOP: 00/00/00

MG/KG	ANALYTICAL RESULTS
20U	SILVER
120	ARSENIC
NA	BORON
520	BARIUM
10U	BERYLLIUM
10U	CADMIUM
20U	COBALT
2900	CHROMIUM
1800	COPPER
20U	MOLYBDENUM
26000	NICKEL
690	LEAD
80U	ANTIMONY
80U	SELENIUM
63	TIN
56	STRONTIUM
100U	TELLURIUM
230	TITANIUM
200U	THALLIUM
47	VANADIUM
20U	YTTRIUM
4600	ZINC
NA	ZIRCONIUM
0.50UJ	MERCURY
5800	ALUMINUM
580	MANGANESE

MG/KG	ANALYTICAL RESULTS
42000	CALCIUM
16000	MAGNESIUM
69000	IRON
28000	SODIUM
4000U	POTASSIUM
18	PERCENT MOISTURE

FOOTNOTES
*A-AVERAGE VALUE *NA-NOT ANALYZED *NAI-INTERFERENCES *J-ESTIMATED VALUE *N-PRESUMPTIVE EVIDENCE OF PRESENCE OF MATERIAL
*K-ACTUAL VALUE IS KNOWN TO BE LESS THAN VALUE GIVEN *L-ACTUAL VALUE IS KNOWN TO BE GREATER THAN VALUE GIVEN
*U-MATERIAL WAS ANALYZED FOR BUT NOT DETECTED. THE NUMBER IS THE MINIMUM QUANTITATION LIMIT.

SAMPLE AND ANALYSIS MANAGEMENT SYSTEM
EPA-ESD,REG IV
ATHENS GEORGIA

09/15/92

TCLP
DATA REPORTING SHEET
WASTE

SAMPLE NO.: 92C70926   SAMPLE TYPE: ASH

PROJECT NO.: 92-0798   PROGRAM ELEMENT: SSF
SOURCE: U.S. PLATING
CITY: ATLANTA   STATE: GA

STATION I.D.: USP3A SURFACE ASH PLATING FACILITY FIRE
STORET STATION NO:

SAMPLE COLLECTION: START DATE/TIME 08/10/92 1530
SAMPLE COLLECTION: STOP DATE/TIME 00/00/00

COLLECTED BY: J RINGWALL   RECEIVED FROM: FEDERAL EXPRESS
SAMPLE REC'D: DATE/TIME 08/12/92 1000   REC'D BY: B COLQUITT
SEALED: YES
CHEMIST: MAW

REMARK:
REMARK:

SAMPLE LOG VERIFIED BY: VAX   SAMPLE DATA VERIFIED BY: MAW

REMARKS

*****ANALYTICAL RESULTS*****

RESULTS	UNITS	PARAMETER
0.10U	MG/L	SILVER
0.36	MG/L	ARSENIC
0.40U	MG/L	BARIUM
0.050U	MG/L	CADMIUM
14	MG/L	CHROMIUM
0.40U	MG/L	LEAD
0.40U	MG/L	SELENIUM
NA	MG/L	MERCURY
110	MG/L	NICKEL
0.40U	MG/L	ANTIMONY

****

FOOTNOTES
*A-AVERAGE VALUE   *NA-NOT ANALYZED   *NAI-INTERFERENCES
*J-ESTIMATED VALUE   *N-PRESUMPTIVE EVIDENCE OF PRESENCE OF MATERIAL
*K-ACTUAL VALUE IS KNOWN TO BE LESS THAN VALUE GIVEN
*L-ACTUAL VALUE IS KNOWN TO BE GREATER THAN VALUE GIVEN
*U-MATERIAL WAS ANALYZED FOR BUT NOT DETECTED. THE NUMBER IS THE MINIMUM QUANTITATION LIMIT.

U.S. PLATING FIRE

	C-1-S	C-2-S	A-1-S	A-2-S	USP1A	USP2A	USP3A	TCLP Regulatory Level
% Solids	90.6	91.4	76.8	73.7				NA
pH	8.1	8.3	7.5	6.1	9.8	0.35	2.9	NA
Total Chromium, mg/kg	71.5	85.1	1,200	617	313	729	2,060	NA
Total Nickel, mg/kg	849	604	1,380	1,010	10,400	8,910	15,400	NA
TCLP Barium, mg/l	1.32	6.26	0.473	0.463	1.983	0.305	1.14	100
TCLP Chromium, mg/l		0.149	0.088		0.136	16.9	68.5	5
TCLP Lead, mg/l		0.103	0.376	0.069	0.349	0.851		5
TCLP Arsenic, mg/l					0.266	1.28	0.237	5

WESTON-GL COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

RECEIVED
2 1992
PROTECTION DIV.
WASTE MGMT BRANCH

19 August 1992

9208-L007-0584

RECEIVED
AUG 20 1992
RFW

Ms. Paula MacLaren
Roy F. Weston, Incorporated
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

RE: TAT-U.S. Plating Analytical Results
RFW Batch 9208G299

Dear Ms. MacLaren:

Please find enclosed the analytical report for the Project and RFW Batch number listed above.

The TCLP results have been bias corrected as specified in the June 29, 1990, Federal Register. The bias correcting procedure requires analyzing each sample twice; once as extracted and once with the extract spiked with all TCLP compounds. The percent recovery of the spike sample is then used as the correction factor for the original sample extract's concentration. Analyses which are already above the hazardous limit are not bias corrected.

Note: The bias correction calculations are performed after the generation of the raw data. Therefore, the final reported result may not match the raw concentration in the instrument data.

If you have any questions, please do not hesitate to contact me.

Very truly yours,

WESTON-GULF COAST, INC.

Eric A. Lang
Project Manager

jb

Enclosures

Approved By:

Michael J. Healy

Michael J. Healy
Laboratory Manager

WESTON

Roy F. Weston, Inc. - Gulf Coast Laboratories
INORGANIC ANALYTICAL DATA PACKAGE FOR
TAT-U.S. Plating

LABORATORY CHRONICLE
DATE RECEIVED: 08/12/92 RFW LOT # :9208G299

CLIENT ID /ANALYSIS	RFW #	MTX	PREP #	COLLECTION	EXTR/PREP	ANALYSIS
C-1-S						
% SOLIDS	001	S	92GTS425	08/07/92	08/13/92	08/13/92
PH	001	S	92GPH264	08/07/92	08/12/92	08/12/92
PH	001 REP	S	92GPH264	08/07/92	08/12/92	08/12/92
TCLP	001	S		08/07/92		08/14/92
C-2-S						
% SOLIDS	003	S	92GTS425	08/07/92	08/13/92	08/13/92
PH	003	S	92GPH264	08/07/92	08/12/92	08/12/92
TCLP	003	S		08/07/92		08/14/92
A-1-S						
% SOLIDS	005	S	92GTS425	08/07/92	08/13/92	08/13/92
PH	005	S	92GPH264	08/07/92	08/12/92	08/12/92
TCLP	005	S		08/07/92		08/14/92
A-2-S						
% SOLIDS	007	S	92GTS425	08/07/92	08/13/92	08/13/92
PH	007	S	92GPH265	08/07/92	08/12/92	08/12/92
TCLP	007	S		08/07/92		08/14/92
USP1A						
PH	009	SO	92GPH264	08/10/92	08/12/92	08/12/92
TCLP	009	SO		08/10/92		08/14/92
USP2A						
PH	011	SO	92GPH265	08/10/92	08/12/92	08/12/92
TCLP	011	SO		08/10/92		08/14/92
USP3A						
PH	013	SO	92GPH265	08/10/92	08/12/92	08/12/92
TCLP	013	SO		08/10/92		08/14/92

LAB QC:

WESTON-GU.. COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

Project # 0000-00-00-0000
Lab Batch: 9208G299

Inorganic Laboratory Control Standards Report

Lab ID	Parameter	Spiked Amount	Units	Spike #1 % Recov.	Spike #2 % Recov.	% Diff.
92GPH264-LCS	pH	7.0	pH	0.1	0.1	NA
92GPH265-LCS	pH	7.0	pH	0.1	0.1	NA

WESTON

Roy F. Weston, Inc. - Gulf Coast Laboratories
INORGANIC ANALYTICAL DATA PACKAGE FOR
TAT-U.S. Plating

LABORATORY CHRONICLE
DATE RECEIVED: 08/12/92 RFW LOT # :9208G299

CLIENT ID /ANALYSIS	RFW #	MTX	PREP #	COLLECTION	EXTR/PREP	ANALYSIS
C-1-S						
CHROMIUM, TOTAL	001	S	92GI553	08/07/92	08/17/92	08/17/92
CHROMIUM, TOTAL	001 REP	S	92GI553	08/07/92	08/17/92	08/17/92
CHROMIUM, TOTAL	001 MS	S	92GI553	08/07/92	08/17/92	08/17/92
NICKEL, TOTAL	001	S	92GI549	08/07/92	08/14/92	08/14/92
NICKEL, TOTAL	001 REP	S	92GI549	08/07/92	08/14/92	08/14/92
NICKEL, TOTAL	001 MS	S	92GI549	08/07/92	08/14/92	08/14/92
C-1-S TCLP						
SILVER, TCLP LEACHAT	002	W	92GE096	08/07/92	08/17/92	08/17/92
SILVER, TCLP LEACHAT	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
SILVER, TCLP LEACHAT	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
ARSENIC, TCLP LEACHA	002	W	92GE096	08/07/92	08/17/92	08/17/92
ARSENIC, TCLP LEACHA	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
ARSENIC, TCLP LEACHA	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
BARIUM, TCLP LEACHAT	002	W	92GE096	08/07/92	08/17/92	08/17/92
BARIUM, TCLP LEACHAT	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
BARIUM, TCLP LEACHAT	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
CADMIUM, TCLP LEACHA	002	W	92GE096	08/07/92	08/17/92	08/17/92
CADMIUM, TCLP LEACHA	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
CADMIUM, TCLP LEACHA	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
CHROMIUM, TCLP LEACH	002	W	92GE096	08/07/92	08/17/92	08/17/92
CHROMIUM, TCLP LEACH	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
CHROMIUM, TCLP LEACH	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
MERCURY, TCLP LEACHA	002	W	92HG315	08/07/92	08/18/92	08/19/92
MERCURY, TCLP LEACHA	002 MS	W	92HG315	08/07/92	08/18/92	08/19/92
LEAD, TCLP LEACHATE	002	W	92GE096	08/07/92	08/17/92	08/17/92
LEAD, TCLP LEACHATE	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
LEAD, TCLP LEACHATE	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	002	W	92GE096	08/07/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	002 REP	W	92GE096	08/07/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	002 MS	W	92GE096	08/07/92	08/17/92	08/17/92
C-2-S						
CHROMIUM, TOTAL	003	S	92GI549	08/07/92	08/14/92	08/14/92
NICKEL, TOTAL	003	S	92GI549	08/07/92	08/14/92	08/14/92

WESTON

Roy F. Weston, Inc. - Gulf Coast Laboratories
INORGANIC ANALYTICAL DATA PACKAGE FOR
TAT-U.S. Plating

LABORATORY CHRONICLE
DATE RECEIVED: 08/12/92 RFW LOT # :9208G299

CLIENT ID /ANALYSIS	RFW #	MTX	PREP #	COLLECTION	EXTR/PREP	ANALYSIS
CHROMIUM, TCLP LEACH	008	W	92GE096	08/07/92	08/17/92	08/17/92
MERCURY, TCLP LEACHA	008	W	92HG315	08/07/92	08/18/92	08/19/92
LEAD, TCLP LEACHATE	008	W	92GE096	08/07/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	008	W	92GE096	08/07/92	08/17/92	08/17/92
USP1A						
CHROMIUM, TOTAL	009	SO	92GI553	08/10/92	08/17/92	08/17/92
CHROMIUM, TOTAL	009 REP	SO	92GI553	08/10/92	08/17/92	08/17/92
CHROMIUM, TOTAL	009 MS	SO	92GI553	08/10/92	08/17/92	08/17/92
NICKEL, TOTAL	009	SO	92GI553	08/10/92	08/17/92	08/17/92
NICKEL, TOTAL	009 REP	SO	92GI553	08/10/92	08/17/92	08/17/92
NICKEL, TOTAL	009 MS	SO	92GI553	08/10/92	08/17/92	08/17/92
USP1A TCLP						
SILVER, TCLP LEACHAT	010	W	92GE096	08/10/92	08/17/92	08/17/92
ILVER, TCLP LEACHAT	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
ARSENIC, TCLP LEACHA	010	W	92GE096	08/10/92	08/17/92	08/17/92
ARSENIC, TCLP LEACHA	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
BARIUM, TCLP LEACHAT	010	W	92GE096	08/10/92	08/17/92	08/17/92
BARIUM, TCLP LEACHAT	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
CADMIUM, TCLP LEACHA	010	W	92GE096	08/10/92	08/17/92	08/17/92
CADMIUM, TCLP LEACHA	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
CHROMIUM, TCLP LEACH	010	W	92GE096	08/10/92	08/17/92	08/17/92
CHROMIUM, TCLP LEACH	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
MERCURY, TCLP LEACHA	010	W	92HG315	08/10/92	08/18/92	08/19/92
MERCURY, TCLP LEACHA	010 MS	W	92HG315	08/10/92	08/18/92	08/19/92
LEAD, TCLP LEACHATE	010	W	92GE096	08/10/92	08/17/92	08/17/92
LEAD, TCLP LEACHATE	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	010	W	92GE096	08/10/92	08/17/92	08/17/92
SELENIUM, TCLP LEACH	010 MS	W	92GE096	08/10/92	08/17/92	08/17/92
USP2A						
CHROMIUM, TOTAL	011	SO	92GI549	08/10/92	08/14/92	08/14/92
NICKEL, TOTAL	011	SO	92GI549	08/10/92	08/14/92	08/14/92
USP2A TCLP						
SILVER, TCLP LEACHAT	012	W	92GE096	08/10/92	08/17/92	08/17/92

WESTON/GULF COAST LABORATORIES, INC.
TCLP EXTRACTION

RFW #	9208G299-002	9208G299-004	9208G299-006	9208G299-008	9208G299-010
RFW # Used for Bias Correction	9208G299-002	→	→	→	299-010
Group #	T-807 m	→	→	→	→
Sample Description	Soil	→	→	→	Solid
Sample Weight (g)	100	→	→	→	→
Liquid-Solid Separation (Yes/No)	No	→	→	→	→
Volume of Mother Liquid (mls)	Na	→	→	→	→
Solid Extraction Material (g)	100	→	→	→	→
Sample Size Specifications	< 9.5 mm	→	→	→	→
Extraction Fluid Selection pH of Initial Solution If <5.0 use Extraction Fluid #1	9.20	9.35	8.44	7.19	9.77
pH of Acid/Heat Treated Soln. If <5.0 use Extraction Fluid #1 If >5.0 use Extraction Fluid #2	1.43	1.44	1.68	1.40	5.21
Extraction Fluid Type (1 or 2)	1	1	1	1	2
Extraction Vessel Type	HDPE	→	→	→	→
Extraction Fluid Volume (mls)	2000	→	→	→	→
Extract Filtered (Yes or No)	Yes	→	→	→	→
Mother Liquid Added (mls)	0NA	→	→	→	→
Combined Filtrate Volume (mls)	2000	→	→	→	→
Final pH Reading	4.97	5.01	5.05	4.97	5.59
Spike Solution Added (mls)	~~501, 504~~ 1	NA	→	→	~~501, 504~~ 1
Spike Source ID #	501, 504	NA	→	→	501, 504
Filtrate Preserved	Yes	→	→	→	→
Start Date/Time	08-13-92 3:25P	→	→	→	→
Start Temperature °C	23.1	→	→	→	→
End Date/Time	08-14-92 8:05 A	→	→	→	→
End Temperature °C	21.5	→	→	→	→

DAK 8/14/92

Extraction Vessel Codes: T = Teflon; Organics/Metals ZHE = Zero Headspace; VOA's HDPE = High Density Polyethylene Metals

Analyst: Debbie Kelly Date: 08-14-92

Reviewer: Ross E. Miller Date: 08/14/92

WESTON/GULF COAST LABORATORIES, INC.
TCLP EXTI TION

RFW #	Blank #2				
RFW # Used for Bias Correction	NA				
Group #	T-807 m				
Sample Description	Extraction Fluid #2				
Sample Weight (g)	NA				
Liquid-Solid Separation (Yes/No)	NA				
Volume of Mother Liquid (mls)	NA				
Solid Extraction Material (g)	NA				
Sample Size Specifications	NA				
Extraction Fluid Selection pH of Initial Solution If <5.0 use Extraction Fluid #1	NA				
pH of Acid/Heat Treated Soln. If <5.0 use Extraction Fluid #1 If >5.0 use Extraction Fluid #2	NA				
Extraction Fluid Type (1 or 2)	2				
Extraction Vessel Type	HDPE				
Extraction Fluid Volume (mls)	2000				
Extract Filtered (Yes or No)	Yes				
Mother Liquid Added (mls)	0 Na				
Combined Filtrate Volume (mls)	2000				
Final pH Reading	2.81				
Spike Solution Added (mls)	NA				
Spike Source ID #	NA				
Filtrate Preserved	Yes				
Start Date/Time	08-13-92 3:25P				
Start Temperature °C	23.1				
End Date/Time	08-014-92 8:05A				
End Temperature °C	21.5				

Extraction Vessel Codes: T = Teflon; Organics/Metals ZHE = Zero Headspace; VOA's HDPE = High Density Polyethylene Metals

Analyst: Debbie Kelly Date: 08-14-92

Reviewer: Ron E. Miller Date: 08/14/92

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: C-1-S
Project # 0000-00-00-0000
Lab ID: 9208G299-001
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result	Units	Reporting Limit
% Solids	90.6	%	0.10
pH	8.1	pH	+-0.20

WESTON MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: A-1-S
Project # 0000-00-00-0000
Lab ID: 9208G299-005
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result	Units	Reporting Limit
% Solids	76.8	%	0.10
pH	7.5	pH	+-0.20

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: USP1A
Project # 0000-00-00-0000
Lab ID: 9208G299-009
Sample Date: 08/10/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result	Units	Reporting Limit
pH	9.8	pH	+-0.20

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-GU . COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: USP3A
Project # 0000-00-00-0000
Lab ID: 9208G299-013
Sample Date: 08/10/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result	Units	Reporting Limit
pH	2.9	pH	+-0.20

TAT-U.S.Plating
9208G299

Spike

Total: All matrix spike recovery results were within the acceptable QC criteria.

TCLP: A portion of the TCLP extract from samples 002 and 012 were spiked with RCRA metals at the TCLP hazardous limit. The spike recovery for this analysis was used for bias correction of the initial measured values as specified in the June 29, 1990 Federal Register.

Mani S. Iyer/Section Manager

8/19/92
Date

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-G[illegible] COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: C-1-S TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-002
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.083	u	mg/L	0.083
Arsenic, TCLP Leachate	0.139	u	mg/L	0.139
Barium, TCLP Leachate	1.32		mg/L	0.057
Cadmium, TCLP Leachate	0.071	u	mg/L	0.071
Chromium, TCLP Leachate	0.068	u	mg/L	0.068
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.069	u	mg/L	0.069
Selenium, TCLP Leachate	0.139	u	mg/L	0.139

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-G... COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: C-2-S TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-004
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.083	u	mg/L	0.083
Arsenic, TCLP Leachate	0.139	u	mg/L	0.139
Barium, TCLP Leachate	6.26		mg/L	0.057
Cadmium, TCLP Leachate	0.071	u	mg/L	0.071
Chromium, TCLP Leachate	0.149		mg/L	0.068
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.103		mg/L	0.069
Selenium, TCLP Leachate	0.139	u	mg/L	0.139

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-GU... COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: A-1-S TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-006
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.083	u	mg/L	0.083
Arsenic, TCLP Leachate	0.139	u	mg/L	0.139
Barium, TCLP Leachate	0.473		mg/L	0.057
Cadmium, TCLP Leachate	0.071	u	mg/L	0.071
Chromium, TCLP Leachate	0.088		mg/L	0.068
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.376		mg/L	0.069
Selenium, TCLP Leachate	0.139	u	mg/L	0.139

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: A-2-S TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-008
Sample Date: 08/07/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.083	u	mg/L	0.083
Arsenic, TCLP Leachate	0.139	u	mg/L	0.139
Barium, TCLP Leachate	0.463		mg/L	0.057
Cadmium, TCLP Leachate	0.071	u	mg/L	0.071
Chromium, TCLP Leachate	0.068	u	mg/L	0.068
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.069		mg/L	0.069
Selenium, TCLP Leachate	0.139	u	mg/L	0.139

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: USP1A TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-010
Sample Date: 08/10/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.148	u	mg/L	0.148
Arsenic, TCLP Leachate	0.266		mg/L	0.138
Barium, TCLP Leachate	1.983		mg/L	0.166
Cadmium, TCLP Leachate	0.067	u	mg/L	0.067
Chromium, TCLP Leachate	0.136		mg/L	0.069
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.349		mg/L	0.128
Selenium, TCLP Leachate	0.138	u	mg/L	0.138

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: USP2A TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-012
Sample Date: 08/10/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.148	u	mg/L	0.148
Arsenic, TCLP Leachate	1.28		mg/L	0.138
Barium, TCLP Leachate	0.305		mg/L	0.166
Cadmium, TCLP Leachate	0.067	u	mg/L	0.067
Chromium, TCLP Leachate	16.9		mg/L	0.069
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.851		mg/L	0.128
Selenium, TCLP Leachate	0.138	u	mg/L	0.138

WESTON MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

RE: USP3A TCLP
Project # 0000-00-00-0000
Lab ID: 9208G299-014
Sample Date: 08/10/92
Date Received: 08/12/92

Inorganic Client Data Report

Parameters	Result		Units	Reporting Limit
Silver, TCLP Leachate	0.148	u	mg/L	0.148
Arsenic, TCLP Leachate	0.237		mg/L	0.138
Barium, TCLP Leachate	1.14		mg/L	0.166
Cadmium, TCLP Leachate	0.067	u	mg/L	0.067
Chromium, TCLP Leachate	68.5		mg/L	0.069
Mercury, TCLP Leachate	0.014	u	mg/L	0.014
Lead, TCLP Leachate	0.128	u	mg/L	0.128
Selenium, TCLP Leachate	0.138	u	mg/L	0.138

WESTON
MANAGERS DESIGNERS CONSULTANTS

WESTON-G... COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

Project # 0000-00-00-0000
Lab Batch: 9208G299

Inorganic Method Blank Data Report

Sample	Lab ID	Parameter	Result		Units	Reporting Limit
Blank 1	92GI553-MB1	Silver, Total	3.0	u	mg/kg	3.0
		Barium, Total	5.0	u	mg/kg	5.0
		Chromium, Total	2.0	u	mg/kg	2.0
		Nickel, Total	2.0	u	mg/kg	2.0
		Lead, Total	5.0	u	mg/kg	5.0
Blank 1	92GI549-MB1	Silver, Total	3.0	u	mg/kg	3.0
		Barium, Total	5.0	u	mg/kg	5.0
		Cadmium, Total	0.50	u	mg/kg	0.50
		Chromium, Total	2.0	u	mg/kg	2.0
		Nickel, Total	2.0	u	mg/kg	2.0
		Lead, Total	5.0	u	mg/kg	5.0
Blank 1	92GE096-MB1	Silver, TCLP Leachate	0.050	u	mg/L	0.050
		Arsenic, TCLP Leachate	0.10	u	mg/L	0.10
		Barium, TCLP Leachate	0.16		mg/L	0.050
		Cadmium, TCLP Leachate	0.050	u	mg/L	0.050
		Chromium, TCLP Leachate	0.050	u	mg/L	0.050
		Lead, TCLP Leachate	0.050	u	mg/L	0.050

WESTON-GL COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

Project # 0000-00-00-0000
Lab Batch: 9208G299

Inorganic Precision Data Report

Sample	Site ID	Parameter	Initial Result		Replicate		% Diff.
-001REP	C-1-S	Chromium, Total	71.5		69.5		2.9
		Nickel, Total	849		822		3.3
-002REP	C-1-S TCLP	Silver, Leachate	0.050	u	0.050	u	NC
		Arsenic, Leachate	0.10	u	0.10	u	NC
		Barium, Leachate	1.1		1.2		5.5
		Cadmium, Leachate	0.050	u	0.050	u	NC
		Chromium, Leachate	0.050	u	0.050	u	NC
		Lead, Leachate	0.050	u	0.050	u	NC
		Selenium, TCLP Leachate	0.10	u	0.10	u	NC
-004REP	C-2-S TCLP	Mercury, Leachate	0.010	u	0.010	u	NC
-009REP	USP1A	Chromium, Total	313		307		2.0
		Nickel, Total	10400		10400		0.14

WESTON MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

Project # 0000-00-00-0000
Lab Batch: 9208G299

Inorganic Accuracy Data Report

Sample	Site ID	Parameter	Spiked Sample	Initial Result		Spiked Amount	% Recov
-001	C-1-S	Chromium, Total	93.7	71.5		22.1	101
		Nickel, Total	899	849		54.7	NA
-002	C-1-S TCLP	Silver, Leachate	3.0	0.050	u	5.0	60.3
		Arsenic, Leachate	3.6	0.10	u	5.0	72.1
		Barium, Leachate	88.6	1.1		100	87.4
		Cadmium, Leachate	0.70	0.050	u	1.0	70.0
		Chromium, Leachate	3.7	0.050	u	5.0	73.4
		Mercury, Leachate	0.15	0.010	u	0.20	73.6
		Lead, Leachate	3.6	0.050	u	5.0	72.6
		Selenium, Leachate	0.72	0.10	u	1.0	71.8
-009	USP1A	Chromium, Total	339	313		19.8	NA
		Nickel, Total	15100	10400		49.5	NA
-010	USP1A TCLP	Silver, Leachate	1.7	0.050	u	5.0	33.8
		Arsenic, Leachate	3.8	0.19		5.0	72.6
		Barium, Leachate	30.8	0.60		100	30.2
		Cadmium, Leachate	0.74	0.050	u	1.0	74.2
		Chromium, Leachate	3.7	0.098		5.0	72.1

WESTON

MANAGERS DESIGNERS CONSULTANTS

WESTON-GULF COAST LABORATORIES, INC.
2417 Bond St., University Park, Illinois 60466
Phones: (708) 534-5200 (219) 885-7077 (815) 723-7533

ANALYTICAL REPORT

To: TAT-U.S. Plating
1575 Northside Drive, NW
325 Atlanta Technology Center
Atlanta, GA 30318-4208

Attn: Ms. Paula MacLaren

Date: Wednesday August 19th, 1992

Project # 0000-00-00-0000
Lab Batch: 9208G299

Inorganic Laboratory Control Standards Report

Lab ID	Parameter	Spiked Amount	Units	Spike #1 % Recov.	Spike #2 % Recov.	% Diff.
92GI553-LC1	Silver, LCS	5.0	mg/kg	95.8	96.8	1.0
	Barium, LCS	200	mg/kg	96.2	96.9	0.80
	Chromium, LCS	20.0	mg/kg	99.2	100	0.70
	Nickel, LCS	50.0	mg/kg	97.9	98.1	0.18
	Lead, LCS	50.0	mg/kg	96.2	97.4	1.2
92GI549-LC1	Silver, LCS	5.0	mg/kg	85.0	87.2	2.6
	Barium, LCS	200	mg/kg	96.0	98.8	2.9
	Cadmium, LCS	5.0	mg/kg	85.8	94.2	9.3
	Chromium, LCS	20.0	mg/kg	95.2	98.6	3.4
	Nickel, LCS	50.0	mg/kg	96.4	98.8	2.4
	Lead, LCS	50.0	mg/kg	92.3	95.6	3.5
92GE096-LC1	Silver, LCS	0.050	mg/L	91.8	97.6	6.1
	Arsenic, LCS	2.0	mg/L	95.0	95.3	0.35
	Barium, LCS	2.0	mg/L	93.5	93.1	0.42
	Cadmium, LCS	0.050	mg/L	90.4	92.4	2.2
	Chromium, LCS	0.20	mg/L	100	97.6	2.4
	Lead, LCS	0.50	mg/L	98.8	97.9	0.85

RECEIVED
2 1993
ENVIRONMENTAL PROTECTION DIV.
HAZARDOUS WASTE MGMT. BRANCH

Mrs. Jeannette Gage
US Plating and Bumper Service Inc.
78 Milton Avenue SE
Atlanta, Georgia 30315

Dear Mrs. Gage:

As I discussed with Stuart Michels of Conversion Technologies, it is acceptable to remove and dispose of the front pile of ash next to the building and dispose of it under all applicable State and local regulations. Our sampling indicated that the front pile of ash was not a hazardous waste.

A sample from the rear area of ash indicated a hazardous waste under the characteristic rule 40 CFR 261.24. This material falls under the land ban rule 40 CFR 268.35 and therefore has to be treated before disposal can take place.

Should you have any questions, please give me a call at (404) 347-3931.

Sincerely,

Charlie Stevens
On-Scene Coordinator

cc Pini Haroz-Conversion Technology, Inc.
Kent Howell-State of Georgia, EPD

① Tim - for the inventory

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

JUN 10 1993

JUN 8 1993

② copy - Renee

Ms. Jennifer Kaduck
Georgia Environmental Protection Division
Department of Natural Resources
205 Butler Street
Suite 1154 - East Tower
Atlanta, Georgia 30334

RE: US Plating and Bumper Service Inc., Atlanta, Georgia

Dear Ms. Kaduck:

On May 12, 1993, the U.S. Environmental Protection Agency's Emergency Response and Removal Branch (ERRB) reviewed the available information for the above referenced site to determine its eligibility for a potential removal action under the National Contingency Plan (NCP). The site information was evaluated using criteria from Section 300.415 of the NCP and current ERRB program guidance.

Based upon ERRB's review, the above site may meet the criteria for low priority removal eligibility. The site is a former plating facility that was consumed in a fire. The owner of the property Ms. Jeannette Gage hired a consultant to take samples of the ash where plating chemicals had spilled. EPA also took samples. There was lab error associated with the samples that EPA sent to a private lab, but the EPA ESD lab results are valid. The consultants samples showed the material not to be a hazardous waste. EPA's one sample showed the ash to be hazardous. To properly determine if the material needs to be disposed of as a hazardous waste the ash may need to be tested again. This site is a low priority for ERRB action. This determination does not preclude any other investigation activities or response actions by other parties which may still be appropriate for this site. Should site conditions change or additional information become available, ERRB will re-evaluate this site as necessary.

Should you have any questions concerning ERRB's determination, please contact Mr. Shane Hitchcock, Chief of Removal Operations Section, at (404) 347-3931.

Sincerely yours,

Myron D. Lair, Chief
Emergency Response and Removal Branch

~~Enclosure~~

cc: Narindar Kumar, Site Assessment Section, EPA

REFERENCE # 40 [redacted]

EPA-600/2-87-035
April 1987

DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings

by

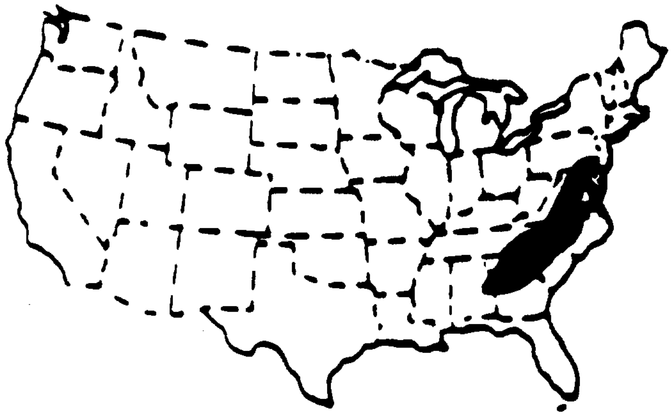
Linda Aller
Truman Bennett
Jay H. Lehr
Rebecca J. Petty
and
Glen Hackett
National Water Well Association
Dublin, Ohio 43017

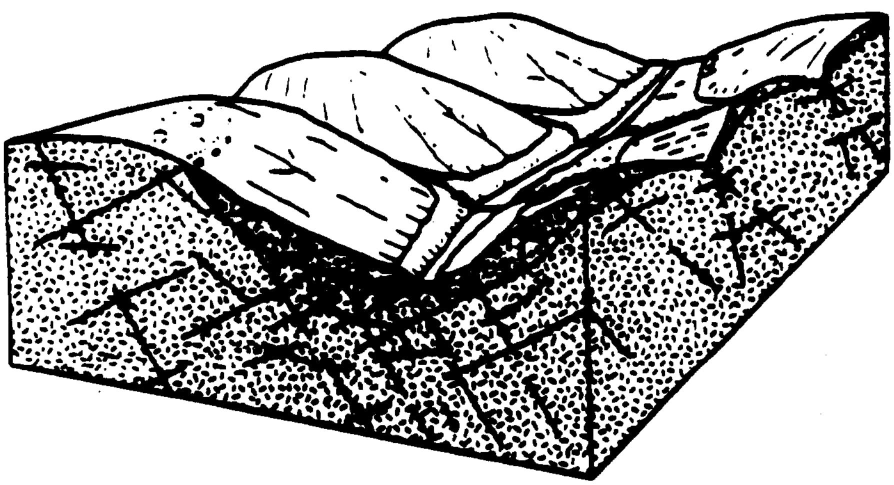
Cooperative Agreement CX-810715-01

Project Officer
Jerry Thornhill
Applications and Assistance Branch
Robert S. Kerr Environmental Research Laboratory
Ada, Oklahoma 74820

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY
OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
ADA, OKLAHOMA 74820

8. PIEDMONT BLUE RIDGE GROUND-WATER REGION





8A	Mountain Slopes
8B	Alluvial Mountain Valleys
8C	Mountain Flanks
8D	Regolith
8E	River Alluvium
8F	Mountain Crests
8G	Swamp/Marsh

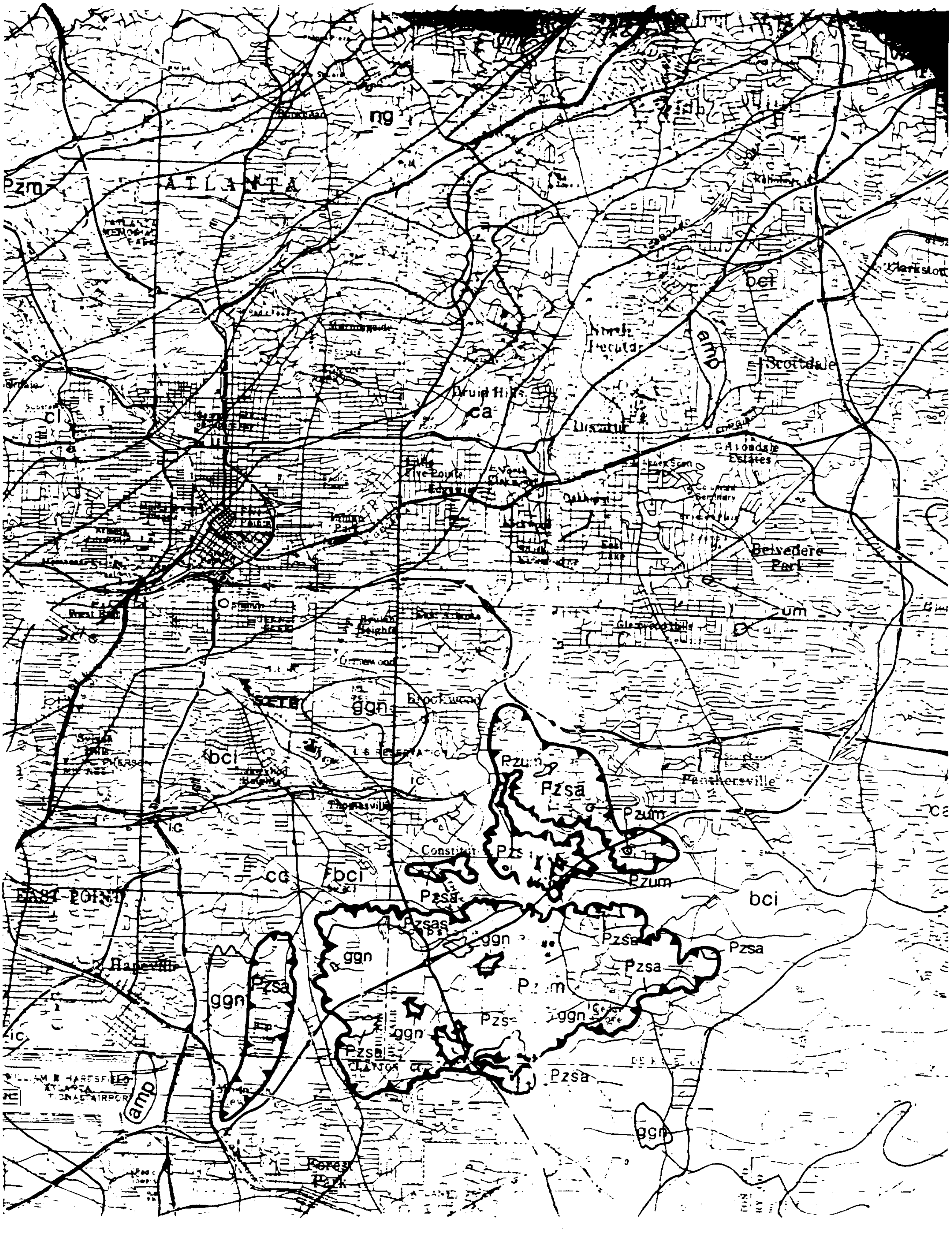
8. PIEDMONT BLUE RIDGE REGION

(Thick regolith over fractured crystalline and metamorphosed sedimentary rocks)

The Piedmont and Blue Ridge region is an area of about 247,000 km^2 extending from Alabama on the south to Pennsylvania on the north. The Piedmont part of the region consists of low, rounded hills and long, rolling, northeast-southwest trending ridges whose summits range from about a hundred meters above sea level along its eastern boundary with the Coastal Plain to 500 to 600 m along its boundary with the Blue Ridge area to the west. The Blue Ridge is mountainous and includes the highest peaks east of the Mississippi. The mountains, some of which reach altitudes of more than 2,000 m, have smooth-rounded outlines and are bordered by well-graded streams flowing in relatively narrow valleys.

The Piedmont and Blue Ridge region is underlain by bedrock of Precambrian and Paleozoic age consisting of igneous and metamorphosed igneous and sedimentary rocks. These include granite, gneiss, schist, quartzite, slate, marble, and phyllite. The land surface in the Piedmont and Blue Ridge is underlain by clay-rich, unconsolidated material derived from in situ weathering of the underlying bedrock. This material, which averages about 10 to 20 m in thickness and may be as much as 100 m thick on some ridges, is referred to as saprolite. In many valleys, especially those of larger streams, flood plains are underlain by thin, moderately well-sorted alluvium deposited by the streams. When the distinction between saprolite and alluvium is not important, the term regolith is used to refer to the layer of unconsolidated deposits.

The regolith contains water in pore spaces between rock particles. The bedrock, on the other hand, does not have any significant intergranular porosity. It contains water, instead, in sheetlike openings formed along fractures (that is, breaks in the otherwise "solid" rock). The hydraulic conductivities of the regolith and the bedrock are similar and range from about 0.001 to 1 m day^{-1}. The major difference in their water-bearing characteristics is their porosities, that of regolith being about 20 to 30 percent and that of the bedrock about 0.01 to 2 percent. Small supplies of water adequate for domestic needs can be obtained from the regolith through large-diameter bored or dug wells. However, most wells, especially those where moderate supplies of water are needed, are relatively small in diameter and are cased through the regolith and finished with open holes in the bedrock. Although, as noted, the hydraulic conductivity of the bedrock is similar to that of the regolith, bedrock wells generally have much larger yields than regolith wells because, being deeper, they have a much larger availble drawdown.



ng
Pzm
ATLANTA
bci
Clarkston
amp
North Decatur
Scottdale
Druid Hills
ca
cl
Decatur
Avondale Estates
East Lake
Belvedere Park
um
ggn
bcl
Pzum
Pzsa
Panthersville
ic
Thomasville
Pzum
Pzum
ca
cc
fbci
bci
EAST POINT
Pzsa
Pzsas
ggn
ggn
Pzsa
Pzsa
Pzsa
Hapeville
ggn
Pzsa
ggn
Pzsa
ggn
ic
amp
Pzsa
Pzsa
ggn
Forest Park

Southern Piedmont and Brevard Fault Zone

(modified after ... 1980, and ...)

Mesozoic

Diabase dikes

Cataclastically sheared rocks ... Brevard Fault Zone ...

Carboniferous

Stone Mountain Granite

Palmetto Granite, includes the Shake Rag phase ... and the Tyrone phase ...

Panola Granite

Ben Hill Granite

Middle Paleozoic

Lithonia Gneiss

Soapstone Ridge Complex ... amphibolite and schist ... coarse-grained ultramafic ...

Snellville Formation, includes the Norris Lake ... Member ... and the Lanier Mountain Quartzite Member ...

Factory Shoals Formation

Chattahoochee Palisades Quartzite

Proterozoic Y and (or) Z and (or) Lower Paleozoic

Atlanta Group

Inman Yard Formation

Promised Land Formation includes the Hannah Member ...

Norcross Gneiss

Wolf Creek Formation

Clairmont Formation

Senoia Formation

Wahoo Creek Formation

Stonewall Formation

Clarkston Formation, includes the Fairburn Member (f), Tar Creek Member (tc), and undifferentiated Clarkston Formation (ca)

Big Cotton Indian Formation

Intrenchment Creek Quartzite

Camp Creek Formation

Sandy Springs Group

Powers Ferry Formation undifferentiated

New Georgia Group

Unassigned and Unnamed Rocks

meta-ultramafic rocks

amphibolite and hornblende ...

predominantly biotite gneiss

granitic gneiss

sillimanite-graphite schist

marble

biotite gneiss, amphibolite, and mica schist undifferentiated

quartzite

biotite muscovite schist

Symbols

CONTACT, DASHED WHERE INFERRED

THRUST FAULT, DASHED WHERE INFERRED

REVERSE FAULT, DASHED WHERE INFERRED, DOTTED WHERE UNCERTAIN

FLINTY CRUSH ROCK

STRIKE-SLIP FAULT

GROUND WATER IN THE GREATER ATLANTA REGION, GEORGIA

by

C. W. Cressler, C. J. Thurmond,

and W. G. Hester

Prepared in cooperation with the

U. S. Geological Survey

Department of Natural Resources

Environmental Protection Division

Georgia Geologic Survey

INFORMATION CIRCULAR 63

GROUND WATER IN THE GREATER ATLANTA REGION, GEORGIA

By

C. W. Cressler, C. J. Thurmond, and W. G. Hester

Georgia Department of Natural Resources
Joe D. Tanner, Commissioner

Environmental Protection Division
J. Leonard Ledbetter, Director

Georgia Geologic Survey
William H. McLemore, State Geologist

Prepared in cooperation with the
U.S. Geological Survey

Atlanta

1983

INFORMATION CIRCULAR 63

GROUND WATER IN THE GREATER ATLANTA REGION, GEORGIA

By C. W. Cressler, C. J. Thurmond, and W. G. Hester

ABSTRACT

The Greater Atlanta Region encompasses about 6,000 square miles in the Piedmont physiographic province of west-central Georgia. Municipal and industrial water supplies in the area are derived mainly from surface water taken from rivers, streams, and impoundments. Large withdrawals now and predicted for the future are causing concern about surface-water sources being able to meet the rising demands. This study was conducted to assess the availability of ground water in the crystalline rocks of the area, and to devise methods for locating sites for high-yielding wells that could provide alternative sources of supply.

The Greater Atlanta Region is roughly divided in half by the Chattahoochee River, which follows a comparatively straight southwesterly course for nearly 110 miles across the area. Streams in the north half of the area, including the Chattahoochee River basin, mainly have rectangular and trellis drainage styles and clearly show the influence of geologic control. The topography and drainage are closely related to bedrock permeability and conventional methods for locating high-yielding well sites apply to most of the area. In contrast, the south half of the area has a superimposed dendritic drainage style in which streams developed more or less independently of the underlying geology. There, the topography and drainage are poorly related to bedrock permeability; many high-yielding wells occupy ridge crests, steep slopes, and bare-rock areas normally considered to be sites of low yield potential.

To better understand the occurrence of ground water in the area, detailed geologic studies were made of 1,051 high-yielding well sites. The results showed that large well yields are available only where aquifers have localized increases in permeability. This occurs mainly in association with certain structural and stratigraphic features, including: (1) contact zones between rocks of contrasting character and also within multilayered rock units, (2) fault zones, (3) stress relief fractures, (4) zones of fracture concentration, (5) small-scale geologic structures that localize drainage development, (6) folds that produce concentrated jointing, and (7) shear zones. Methods for selecting high-yielding well sites using these structural and stratigraphic features are outlined in the report.

Borehole geophysical techniques were used to study the nature of water-bearing openings. Sonic televiewer logs revealed that in several wells the water-bearing openings consist of horizontal or nearly horizontal fractures 1 to 8 inches in vertical dimension. The fractures were observed in granitic gneiss, biotite gneiss, gneiss interlayered with schist, and in quartz-mica schist. The writers believe the openings are stress relief fractures formed by the upward expansion of the rock column in response to erosional unloading. Core drilling at two well sites confirmed the horizontal nature of the fractures and showed no indication of lateral movement that would associate the openings with faulting.

Wells that derive water from horizontal fractures characteristically remain essentially dry during drilling until they penetrate one or two high-yielding fractures. The fractures are at or near the bottom of the wells. The high-yielding fractures are at or near the bottom of wells because: (1) the large yields were in excess of the desired quantity and, therefore, drilling ceased, or (2) in deep wells yielding 50 to 100 gal/min or more, the large volume of water from the fracture(s) "drowned out" the pneumatic hammers in the drill bits, effectively preventing deeper drilling. Twenty-five wells in the report area are known to derive water from bottom-hole

fractures, all of which are believed to be horizontal stress relief fractures. Other wells in the area are reported to derive water from bottom-hole fractures, which also are believed to be stress relief fractures. These wells occupy a variety of topographic settings, including broad valleys, ridge crests, steep slopes, and bare-rock areas, indicating that stress relief fractures are present beneath uplands and lowlands alike.

Wells deriving water from stress relief fractures have much greater average depths than wells reported from other crystalline rock areas. Many of the wells are 400 to 550 feet or more deep and derive water from a single fracture at the bottom of the hole. In one area, 62 percent of the wells that supply 50 gallons per minute or more are from 400 to more than 600 feet deep. The chance of obtaining large well yields from stress relief fractures is significantly increased by drilling to about 620 feet.

In general, moderate quantities of ground water presently are available in the report area. Most of the 1,165 high-yielding wells that were inventoried during this study supply from 40 to more than 200 gallons per minute. The distribution of these wells with respect to topography and geology indicates that most were located for the convenience of the users and that the large yields resulted mainly from chance, rather than from thoughtful site selection. By employing the site selection methods outlined in this report, it should be possible to develop large supplemental ground-water supplies in most of the area from comparatively few wells.

Coweta, Fayette, Henry, and Clayton Counties in the south part of the area that include the communities of Newnan, Shenandoah, Peachtree City, and Fayetteville are expected to grow rapidly during the next 25 years. Because of unfavorable quality conditions in the Chattahoochee River, these communities and surrounding areas are being forced to turn to small, marginal streams as water-supply sources. These streams are vulnerable to pollution from nonpoint sources and are seriously affected by prolonged drought. For these reasons, the southern Atlanta area is one that can benefit greatly from supplemental ground-water supplies. At present, all of Coweta County outside the city of Newnan uses ground water exclusively, and much of the four-county area soon may require ground water for supplemental or primary sources of supply. Large quantities of ground water are available in the four counties, as indicated by the presence of 168 wells that supply 40 to more than 200 gallons per minute.

Contrary to popular belief, many wells in the Greater Atlanta Region are highly dependable and have records of sustaining large yields for many years. Sixty-six mainly industrial and municipal wells have been in use for periods of 12 to more than 30 years without experiencing declining yields.

Well water in the area generally is of good chemical quality and is suitable for drinking and most other uses. Concentrations of dissolved constituents are fairly consistent throughout the area, and except for iron, rarely exceed drinking water standards.

INTRODUCTION

Municipal and industrial water supplies in the Greater Atlanta Region (GAR) are derived almost exclusively from surface water taken from rivers, streams, and impoundments. Large withdrawals now and predictions for future needs are causing concern about the present metropolitan area systems being able to meet the anticipated demand. Public pressure is mounting against drawing down recreation and power generation reservoirs to obtain additional water. Thus, there is a great need to assess the availability of ground water in the crystalline rocks of the GAR as a possible alternative source of supply for communities and potential industry outside the existing surface systems.

Because of generally low permeability, crystalline rocks have the reputation for furnishing only small quantities of ground water, generally 2 to 30 gal/min, suitable mainly for domestic and farm purposes. As a result, many engineering firms and consultants no longer consider ground water a practical source of supply. This has severely limited the economic development of vast areas not served by municipal or county water systems.

There are, however, a significant number of wells in the GAR that produce 100 to almost 500 gal/min. The fact that most of these wells were located without regard to topography or geology indicates that other high-yielding wells could be developed at numerous selected sites in the GAR. A study was needed that would provide methods for locating wells in the GAR that could be expected to supply large quantities of ground water for supplementing the existing surface-water sources.

This project was part of a long-range plan to appraise the ground-water resources of Georgia, with particular emphasis on high-growth areas. The data collected and used will be entered into the U.S. Geological Survey computer-stored data bank and, along with the published report, will be available to answer information requests and help municipal, industrial, and other planning agencies.

Area of Study

The GAR as used in this report includes an area of about 6,000 mi^2 in west-central Georgia (fig. 1). The study initially was limited to the area covered by the U.S. Geological Survey "Greater Atlanta Region" (1974), 1:100,000-scale topographic map, but later was expanded to include counties along the southern border of the map. As the study is concerned only with metamorphic and igneous rocks of the Piedmont physiographic province, it excludes the northwestern part of the mapped area, which is in the Valley and Ridge physiographic province. All or parts of 27 counties comprise the study area: Barrow, Bartow, Butts, Carroll, Cherokee, Clayton, Cobb, Coweta, Dawson, DeKalb, Douglas, Fayette, Forsyth, Fulton, Gwinnett, Hall, Haralson, Heard, Henry, Jasper, Newton, Paulding, Pickens, Polk, Rockdale, Spalding, and Walton Counties. The 1980 population of the GAR was about 2,000,000.

Objectives and Scope

The objectives of the study were to assess the quantity and chemical quality of ground water available in the GAR, and to develop methods for locating high-yielding well sites in various geologic and topographic settings throughout the area.

In the GAR, more than 1,165 high-yielding wells (yielding a minimum of 20 gal/min) were inventoried and accurately located on topographic maps by field checking. All of the well sites were analyzed to evaluate the correlation between well yield and topographic setting.

Detailed field studies were conducted on 1,051 well sites to learn the types of geologic and topographic settings that supply large well yields. These studies assessed (1) the local geology and structure of each site to identify the wells that derive water from fault zones, contact zones, and similar features; (2) the relation between topographic setting and geology, to detect sites where the large yields result from a relation of topography to small-scale structures in the rocks; and (3) the relation of the high-yielding wells to the depth and yield of nearby wells to define and delineate the water-bearing openings that supply the large yields. These determinations were used to develop methods for selecting

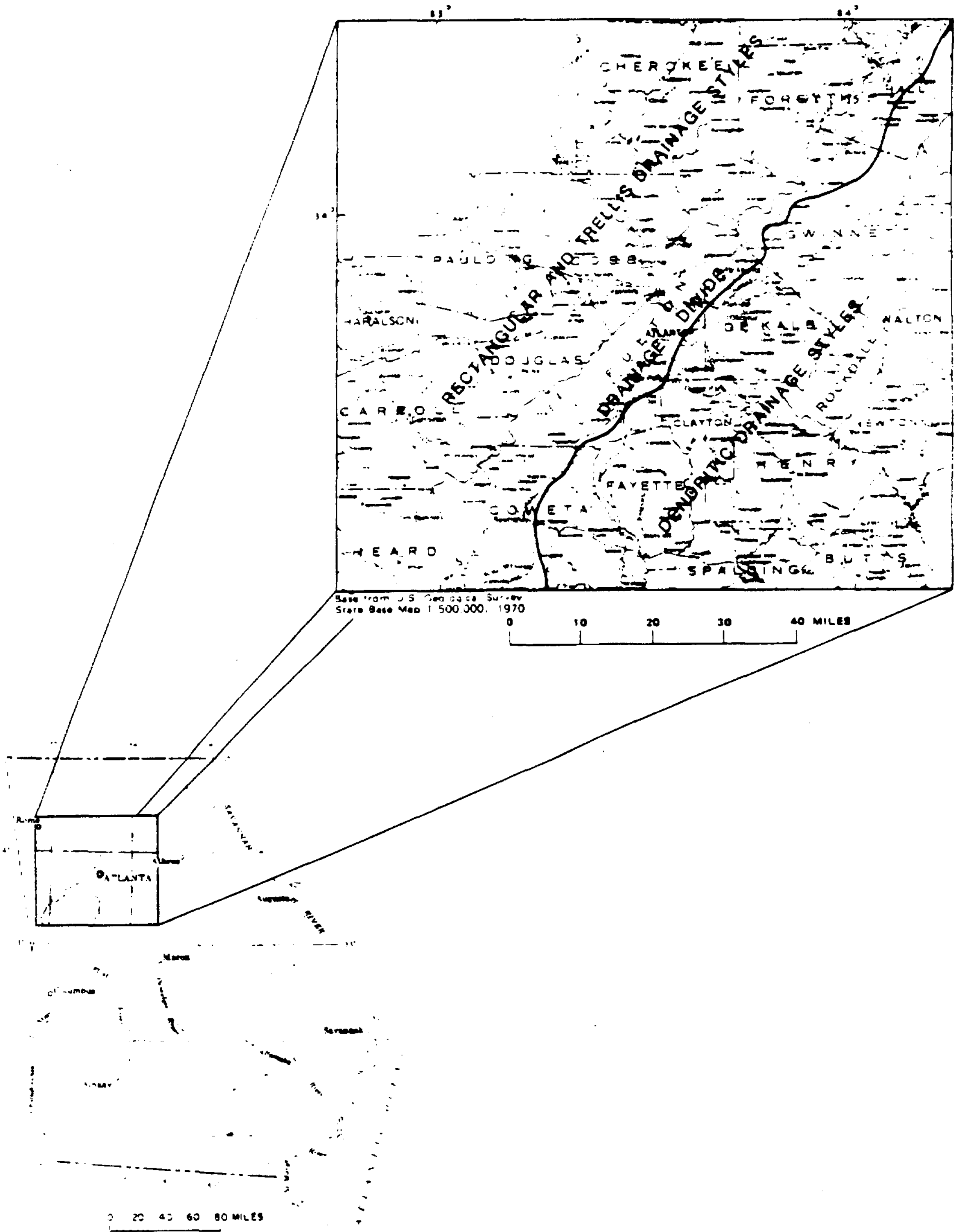


Figure 1. Location of study area.

high-yielding well sites in a variety of geologic and topographic settings throughout the GAR.

The nature and occurrence of water-bearing openings in various rock types were studied by using borehole geophysical techniques. Sonic televiewer logs of well bores were the best available means of learning the character of deep-seated fractures that supply large well yields in places of seemingly low yield potential.

Three test wells were drilled to investigate the yield potential of different geologic settings and to learn the nature of water-bearing openings. Pumping tests were run on two of the test wells to provide drawdown and recovery data needed to estimate yields. Core drilling was done beside two wells to confirm the horizontal nature of water-bearing fractures observed by borehole geophysical logs. A fourth test well was drilled to learn whether a linear feature was underlain by a zone of fracture concentration.

High-yielding well sites and water-bearing units were studied in detail in Coweta, Fayette, Clayton, and Henry Counties in an attempt to discover methods for locating sites capable of supplying large quantities of well water. Large quantities of well water soon may be needed in these counties for supplemental supply.

Physiography and Climate

Most of the report area is a broad rolling upland or plateau that, as a whole, is topographically homogeneous. Almost all of the cities and larger towns are on uplands, away from the rivers and broad valleys (LaForge and others, 1925). The plateau is inclined to the southeast, having average altitudes of 1,000 to 1,200 ft in the northwest and about 700 ft in the southeast. The maximum altitude is 2,300 ft on Pinelog Mountain in Cherokee County; the minimum altitude is 527 ft at Jackson Lake in Newton County. The average altitude of the report area is about 1,000 ft.

The northwestern part of the area is drained by the Chattahoochee and Coosa Rivers. The southeastern part is drained by the Flint and Ocmulgee Rivers.

Major cities in the area include Atlanta, Gainesville, Marietta, Decatur, Newnan, Carrollton, Conyers, Covington, Canton, Cumming, and Lawrenceville.

The area has a mild climate with slightly cooler temperatues and a little less rainfall than the State averages. In Fulton County, the average January temperature is 44°F and the average July temperature is 78°F. Average annual rainfall is 47 to 48 inches, compared to a State average of 54 inches. There are two peak-rainfall periods: late winter and midsummer.

Previous Investigations

One of the earliest reports on ground water in the GAR appeared in McCallie's "Underground Waters of Georgia" (1908). A report by Herrick and LeGrand (1949) discussed the geology and ground-water resources of the Atlanta area. Their report covered 2,055 mi^2 of the "Atlanta area" and included data on dug, bored, and drilled wells.

A 1951 report by Carter and Herrick on water resources of the Atlanta Metropolitan Area summarized ground-water data from the Herrick and LeGrand (1949) report, and also discussed availability and quality of surface water in the area. Thomson and others (1956) reported on "The Availability and Use of Water in Georgia," in which the occurrence of ground water in the Piedmont was briefly discussed. Stewart and Herrick (1963) reported on emergency water supplies for the Atlanta area. McCollum (1966) investigated the ground-water resources and geology of Rockdale County, one of the 27 counties included in the present study.

Cressler (1970) reported on the geology and ground-water resources of Floyd and Polk Counties. Cressler and others (1979) presented results of a study on geohydrology in Cherokee, Forsyth, and eastern Bartow Counties.

LaForge and others (1925) discussed the drainage systems of the Georgia Piedmont. Staheli (1976) reported on drainage styles of the area's streams that have a bearing on the distribution of ground water in the GAR.

Acknowledgments

This study was made by the U.S. Geological Survey in cooperation with the Georgia Department of Natural Resources, Geologic Survey Branch. The authors wish to acknowledge the many people who gave assistance during this study. Hundreds of property owners throughout the study area willingly supplied information about their wells and permitted access to their property. The following companies and personnel furnished construction and yield data on large-yielding wells:

Mr. W. A. Martin and Mrs. Mary Dutton, Virginia Supply and Well Co., Atlanta
Mr. Jim Adams and Mrs. Willie A. Massey, Adams-Massey Well Drilling Co., Carrollton
Mr. and Mrs. Ed Livingston, Explora Contractors, Inc., Conyers
Mr. and Mrs. Hoyt W. Waller, Waller Well Co., Griffin
Mr. Ray Ward of Ward Drilling Co., Inc., Powder Springs
Mr. and Mrs. H. G. Holder, Holder Well Co., Covington
Mr. Jimmy Fowler, Fowler Well Co., Cumming
Mr. P. T. Price, Price Well Co., Dallas
Weisner Drilling Co., Inc., Riverdale
Askew Water Systems, Griffin

Thomas J. Crawford of West Georgia College devoted long hours to discussing the occurrence and availability of ground water in the western part of the report area, especially Carroll County. Many of his observations and methods for selecting well sites are included in this report. He also provided construction, yield, geologic, and location data for hundreds of wells in the Carroll County area.

City clerks and water department personnel provided information on locations, histories, and use of wells in numerous towns and cities of the GAR. These included the cities of Conyers, Hampton, Clarkston, Acworth, Lawrenceville, Flowery Branch, Senoia, Milstead, Riverdale, Jonesboro, Grayson, Brooks, Peachtree City, and Turin.

Appreciation is extended to Janet K. Groseclose for assistance in preparation of this manuscript.

Well-Numbering System

The GAR is covered by 111 7.5-minute topographic quadrangles and parts of quadrangles. Wells in this report are numbered according to a system based on the 7.5-minute topographic quadrangle maps of the U.S. Geological Survey. Each 7.5-minute quadrangle in Georgia has been given a number and a letter designation according to its location. The numbers begin in the southwest corner of the State and increase numerically eastward. The letters begin in the same place, but progress alphabetically to the north, following the rule of "read right up." Because the alphabet contains fewer letters than there are quadrangles, those in the northern part of the State have double letter designations, as in 9HH. (Refer to fig. 37.)

Wells in each quadrangle are numbered consecutively, beginning with number 1, as in 8CC1. Complete well numbers, as in 5CC11, are used in well tables and most illustrations. On plate 1 the well numbers lack quadrangle designations because of space limitations. The quadrangle designations for these wells can be obtained from figure 37 and from the inset on plate 1.

In table 7, which lists chemical analyses of well water, some wells retain numbers used in previous reports.

WATER-BEARING UNITS AND THEIR HYDROLOGIC PROPERTIES

The part of the GAR included in this study lies wholly within the Piedmont physiographic province (Clark and Zisa, 1976; Fenneman, 1938). The area is underlain by a complex of metamorphic and igneous rocks that have been divided by various workers into more than 50 named formations and unnamed mappable units. Individual rock units range in thickness from less than 10 ft to possibly more than 10,000 ft.

Regional stresses have warped the rocks into complex folds and refolded folds, and the sequence has been injected by igneous plutons and dikes and broken by faults. Erosion of these folded and faulted rocks produced the complex outcrop patterns that exist today. The large number of rock types in the area and their varied outcrop patterns greatly complicate the occurrence and availability of ground water in the area. Nevertheless, many of the more than 50 named formations and unnamed mappable units in the GAR are made up of rocks that have similar physical properties and yield water of comparable quantity and chemical quality. Thus, for convenience, the rocks in the report area have been grouped into nine principal water-bearing units and assigned letter designations. The areal distribution of the water-bearing units and their lithologies are shown on plate 1. Data on wells in the water-bearing units are summarized in tables 1-3.

OCCURRENCE AND AVAILABILITY OF GROUND WATER

Ground water in the GAR occupies joints, fractures, and other secondary openings in bedrock and pore spaces in the overlying mantle of residual material. Water recharges the underground

Table 1.--Summary of well data for the Greater Atlanta Region

Water-bearing unit	Number of wells	Yield (gal/min)		Depth (ft)		Casing depth (ft)		Topography (percent of wells in each setting)						
		Range	Average	Range	Average	Range	Average	Slope	Broad lowlands	Uplands-ridge crests	Draw, hollow	Stream or lake	Saddle	Other
A Amphibolite-gneiss-schist	385	20–275	56	35–2,175	294	0–200	60	22	35	22	4	11	2	4
B Granitic gneiss	166	20–368	72	40–825	271	3–266	54	33	45	2	14	6	0	0
C Schist	185	20–150	47	67–700	195	4–144	53	19	19	27	20	11	4	0
D Biotite gneiss	70	20–351	56	82–710	270	7–140	56	20	27	36	6	11	0	[illegible]
E Mafic	32	20–471	79	67–386	191	8–116	46	17	35	28	3	17	0	
F Granite	43	20–150	43	43–422	192	11–187	57	30	30	15	15	10	0	
G Cataclastic	55	20–225	74	110–800	323	9–207	84	4	75	15	4	2	0	
H Quartzite	12	20–200	72	122–500	297	30–35	58	45	9	27	18	0	0	
J Carbonate	5	31–150	76	240–505	376	28–314	138	0	100	0	0	0	0	

[illegible] Atlanta Region

Water-bearing unit	Number of wells	Yield (gal/min)		Depth (ft)		Casing depth (ft)		Topography (percent of wells in each setting)						
		Range	Average	Range	Average	Range	Average	Slope	Broad lowlands	Uplands-ridge crests	Draw, hollow	Stream or lake	Saddle	Other
A Amphibolite-gneiss-schist	107	20–200	53	55–675	220	12–187	52	25	28	23	9	12	2	1
B Granitic gneiss	6	20–200	81	170–337	235	31–140	68	50	0	33	0	17	0	0
C Schist	127	20–150	46	67–600	183	4–144	53	16	14	26	26	12	6	0
D Biotite gneiss	16	25–110	54	98–500	252	14–129	65	18	9	36	18	18	0	0
E Mafic	11	20–100	47	67–375	148	10–80	43	22	45	33	0	0	0	0
F Granite	17	20–75	39	43–398	152	11–72	38	20	33	7	27	13	0	0
G Cataclastic	0	—	—	—	—	—	—	—	—	—	—	—	—	—
H Quartzite	10	20–200	71	122–500	280	30–85	57	56	0	22	22	0	0	0
J Carbonate	4	31–85	58	240–505	399	28–314	164	0	100	0	0	0	0	0

Table 3.—Summary of well data for the south half of the Greater Atlanta Region

Water-bearing unit	Number of wells	Yield (gal/min)		Depth (ft)		Casing depth (ft)		Topography (percent of wells in each setting)						
		Range	Average	Range	Average	Range	Average	Slope	Broad lowlands	Uplands-ridge crests	Draw, hollow	Stream or lake	Saddle	Other
A Amphibolite-gneiss-schist	278	20–275	58	35–2,175	320	0–200	63	20	38	22	3	10	2	5
B Granitic gneiss	160	20–348	72	40–825	273	3–266	54	23	33	30	10	4	0	0
C Schist	58	20–150	48	72–700	243	19–125	56	24	32	26	8	8	6	0
D Biotite gneiss	54	20–351	56	82–710	275	7–140	53	21	32	36	2	9	0	0
E Mafic	21	25–471	116	83–386	214	8–116	47	15	30	25	5	25	0	0
F Granite	26	20–150	45	77–422	218	14–127	69	36	28	20	8	8	0	0
G Cataclastic	55	20–225	74	110–600	323	8–207	54	4	75	15	4	2	0	0
H Quartzite	2	50–100	75	240–500	370	—	62	0	50	50	0	0	0	0
J Carbonate	1	150	—	285	—	32	—	0	100	0	0	0	0	0

openings by seeping through this material or by flowing directly into openings in exposed rock. This recharge is from precipitation that falls in the area.

Unweathered and unfractured bedrock in the report area has very low porosity and permeability. Thus, the quantity of water that a rock unit can store is determined by the capacity and distribution of joints, fractures, and other types of secondary openings. The quantity of stored water that can be withdrawn by wells depends largely on the extent to which the rock openings are interconnected.

The size, spacing, and interconnection of openings differ greatly from one type of rock to another and with depth below land surface. Open joints and fractures tend to become tighter and more widely spaced with increasing depth. Joints and other openings in soft rocks such as phyllite tend to be tight and poorly connected; wells in rocks of this character generally have small yields. On the other hand, openings in more brittle rocks such as quartzite and graywacke tend to be larger and are better connected; wells in these rocks normally supply greater yields. Other rocks, including amphibolite, schist, and gneiss, are variable in the size and connection of secondary openings and generally yield small to moderate quantities of water to wells. Carbonate rocks, which include marble, can contain much larger and more extensively interconnected fracture systems. Openings in carbonate rocks commonly are enlarged by solution, and are capable of transmitting large quantities of water.

Effects of Drainage Style

The GAR is divided nearly in half by the Chattahoochee River, which follows a comparatively straight southwesterly course for nearly 110 miles across the area (fig. 1). Streams in the north half of the area, including the Chattahoochee River and its tributaries, mainly have rectangular and trellis drainage styles. In contrast, streams in the south half of the area, beginning at about the south edge of the Chattahoochee River basin, have a dendritic drainage style (Staheli, 1976).

Streams having rectangular drainage style flow in strongly angular courses that follow the rectangular pattern of the joints that break up the rocks. Areas having trellis drainage style are characterized by strongly folded and dipping rocks; the larger streams follow the outcrops of less resistant rocks and tributaries enter at right angles across the dip of the strata (Lobeck, 1939, p. 175). All of the streams in the north half of the area show the influence of geologic control, their drainage styles reflecting the varied outcrop pattern, the different lithologies present, and the geologic structure.

In the south half of the area, the dendritic drainage style is indicative of streams that developed independently of the underlying geology (LaForge and others, 1925; Staheli, 1976). According to Staheli (1976, p. 451), dendritic drainage, in which streams run in all directions like the branches of a tree, probably was established on some preexisting surface and later superimposed on the underlying crystalline rocks. Such streams are said to be superimposed when they acquire a course on nearly flat-lying material that covered the rocks beneath. Streams flowing on the veneer of material that covers the bedrock are superimposed above the concealed rocks. When rejuvenated by uplift, they become incised and develop courses without regard to the structure or lithology of the underlying rocks. Eventually, the cover material may be entirely removed and then only the physiographic pattern of the streams will suggest their having been let down from a superimposed position (Lobeck, 1939, p. 173).

According to Staheli (1976, p. 451), to explain the different drainage styles in regions underlain by similar rocks and structures, it is suggested that an earlier Coastal Plain sedimentary cover buried the Piedmont and extended inland at least to the Chattahoochee River valley. Thus, according to Staheli, drainage to the north developed originally on Piedmont rocks and so reflects their structural orientations. Staheli believes that streams south of the Chattahoochee River valley developed as consequent streams on a flat Coastal Plain cover. These streams extended headward as sea levels lowered, developed dendritic drainage, and eventually became superimposed across regional Piedmont structures. Thus, the general area of the Chattahoochee River valley might well coincide with a fossil Fall Line in Georgia (Staheli, 1976, p. 451). As Staheli points out, in areas near the Chattahoochee River, the drainage pattern suggests that higher, more resistant rocks could have existed as islands that locally controlled stream development even though the lower areas were covered by Coastal Plain sediment. For example, drainage obviously has been diverted by such prominences as Stone Mountain.

Observations made during the present study indicate that in the south half of the GAR, many of the smaller elements of the drainages, such as draws, hollows, and intermittent streams in the uppermost headwaters areas seem to have developed under geologic control. The presence of geologic control is indicated by smaller drainages that parallel prominent joint sets or that are alined with bedrock foliation. Presumably these late-forming drainages were established after removal of a preexisting cover and, therefore, developed under geologic control. The fact that the smaller drainages may reflect bedrock weaknesses, whereas the larger streams generally may not, has a profound influence on the occurrence of ground water in the south half of the GAR and on the methods that can be used successfully to locate large ground-water supplies. The relations between drainage styles and the occurrence of ground water, and the effects that drainage styles have on the methods that can b used to locate sites for high-yieldin wells, are discussed in later sections c this report.

AVAILABILITY OF LARGE GROUND-WATER SUPPLIES

The quantity of ground water availabl in the GAR varies greatly with the loca tion, rock type, topographic setting drainage style, and the geologic struc ture. In some areas, most wells yiel less than 3 gal/min, which generally i considered a minimum requirement fo domestic and stock supplies. In mor favorable areas, yields commonly rang between 3 and 10 gal/min. It should b pointed out, however, that obtaining thi quantity may require drilling in mor than one site.

High-yielding wells—ones that suppl 20 gal/min or more—generally can be de veloped only where the rocks possess lo calized increases in permeability. Thi occurs mainly in association with certai structural and stratigraphic features including: (1) contact zones betwee rock units of contrasting character, (2 contact zones within multilayered roc units, (3) fault zones, (4) stress relie fractures, (5) zones of fracture concen tration, (6) small-scale structures, in cluding joints, foliation planes, an fold axes, that localize drainage devel opment, (7) folds that produce concentra ted jointing, and (8) shear zones. Othe factors, such as topographic setting drainage style, rock type, depth o weathering, thickness of soil cover, an the pervasiveness and orientation of fol iation can interact to increase or de crease the availability of ground water The nature and occurrence of structura and stratigraphic features known to in crease bedrock permeability, and the re lation of these features to drainag style, topography, and other factors, ar discussed in the following sections.

Contact Zones

Yields of 50 to 200 gal/min may be obtained from contact zones between rock units of contrasting character. The largest yields generally are obtained where massive homogeneous rocks such as granite, which are very resistant to weathering, are in contact with foliated rocks of high feldspar content that weather rapidly and deeply. The most productive contacts generally are ones in which a resistant rock is overlain by a rapidly weathering rock (T. J. Crawford, West Georgia College, oral commun., 1979). Examples of rock types and certain physical characteristics of rocks that form productive contact zones are shown below:

1. Granite or granitic gneiss overlain by schist low in quartz content.
2. Granite overlain by hornblende, feldspar (50 percent) gneiss.
3. Granite overlain by feldspar gneiss.
4. Massive granite overlain by foliated gneiss.
5. Massive, homogeneous rocks, poorly jointed and foliated and resistant to weathering, overlain by foliated, well-jointed, deeply weathering rocks (feldspar-rich and foliated rocks weather most rapidly and deeply).

To produce the highest yields, the rocks overlying the massive homogeneous rock should be: (1) foliated, (2) have a high feldspar content, the higher the better, (3) differ mineralogically, and (4) occupy a topographic position favorable to recharge.

Contact zones occur throughout the GAR. Many potentially high-yielding contacts are shown on plate 1, and on detailed geologic maps that are available for parts of the area. (See references.) Contact zones between rock units of contrasting character generally may be recognized in road cuts, quarries, and freshly scraped areas, and their presence also may be indicated by changes in the character of the saprolite and by changes in topography. For example, the contact between granite or granitic gneiss and a feldspathic schist may be indicated by sandy soil or saprolite containing small mica flakes derived from the granite or gneiss, that abruptly changes to a clay soil containing large mica flakes derived from the schist. Also, the area underlain by granite or gneiss may be characterized by numerous exposures of fresh rock, whereas the schist area may have no rock exposed. Contact zones between resistant and less resistant rocks also may be indicated by subtle changes in topography. The terrain over the weaker rocks may be slightly lower and flatter than that over the resistant rocks. Valleys and draws may trend parallel to the contact zone.

In the north half of the GAR, wells derive large yields from several types of contact zones. Well 12HH6 furnishes 150 gal/min to the city of Cumming, Forsyth County, from quartzite of Unit H at the contact with schist of Unit C. Well 5CC-39 in Carroll County supplies a subdivision with 100 gal/min from a contact zone between "granite" of Unit F and schist of Unit C.

In the south half of the area, comparatively few wells supply water from contact zones between rock units of contrasting character. This probably is because in an area dominated by dendritic drainage, the contacts rarely occupy topographic settings that favor increased ground-water circulation. Large yields are, however, supplied by wells that tap contact zones between mafic rocks of Unit E and various types of country rock. Well 14DD2, near Milstead in Rockdale County, supplies 100 gal/min from a contact between a diabase dike (Unit E) and granitic gneiss of Unit B. Contact zones between differing rock units are widespread in the south half of the area and may be productive where they underlie draws, stream valleys, and other low areas that favor increased ground-water circulation and provide adequate recharge.

Other potentially permeable contact zones occur between rock layers of different character within multilayered rock units such as Unit A. Areas underlain by Unit A are shown on plate 1. Although individual contact zones cannot be shown on maps of the scale used in this report, they may be located by field surveys. Contact zones of this type supply water to wells in both the north and south halves of the area. Well 12HH7 in Forsyth County derives 90 gal/min from contact zones within the multilayered rock of Unit A.

The yield potential of individual contact zones may be estimated from their topographic settings, especially their relation to local drainages. The largest yields generally can be expected from contacts that lie in and trend parallel to draws and stream valleys that are downgradient from sizable catchment areas overlain by deep soil. Contacts that cross such drainages at various angles also may be productive. Contact zones in multilayered rock units generally supply the largest yields to wells drilled on the downdip side of draws and stream valleys that parallel the contacts.

Construction of the "people mover" tunnel at Hartsfield-Atlanta International Airport provided an opportunity to observe firsthand the effects that topographic setting, catchment area size, and quantity of available recharge have on the long-term yield potential of contact zones in multilayered rocks. The tunnel site, which extended in an east-west direction for nearly a mile (fig. 2) over interlayered schist, gneiss, and amphibolite of Unit A and gneiss of Unit B, was being dewatered along the north and south sides by wells drilled at intervals of about 100 ft. The dewatering wells were 110 ft deep, gravel packed to the top of rock, and lined with slotted casing total depth. Observation wells 60 ft more deep and gravel packed to tot depth were spaced every 200 ft along bo sides of the tunnel site to permit t monitoring of water levels.

The initial yields of the dewateri wells reportedly ranged from near 0 about 70 gal/min, averaging about gal/min. Submersible pumps installed each well discharged water at the rate about 17 gal/min, cycling on and off needed to prevent excessive drawdown. the dewatering operation progressed, ma pumps were off most of the time; only t highest yielding wells pumped steadil

Because new groups of wells were i termittently completed and brought line, and older wells were pumping le often, the most practical means of dete mining the total pumpage of the dewate ing wells was to measure the flow in dis charge ditches that collected water fr wells on the north and south sides of t tunnel site. The first measurement, ma February 2, 1977, showed the total pum age to be about 100 gal/min (not accoun ing for evapotranspiration or seepage With the addition of more pumping well the discharge increased to about 1,0 gal/min on August 1. By October 10, ma wells had stopped pumping and the tot discharge declined to about 500 gal/mi On January 11, 1978, the flow was reduc to about 100 gal/min and by March 31 t flow, which was too small to measure wi a pigmy current meter, was estimated be less than 50 gal/min. The flow in t discharge ditches remained too low measure for the remainder of the dewate ing operation. By June 28, 1978, mo wells had stopped pumping and the highe yielding wells were cycling irregularly.

The dewatering operation proved su cessful for the intended purpose of lo ering the water table below the bottom the construction ditch. Ground-wate levels at the beginning of the operati ranged from about 4 to 12 ft below la surface. With the start of pumping, t

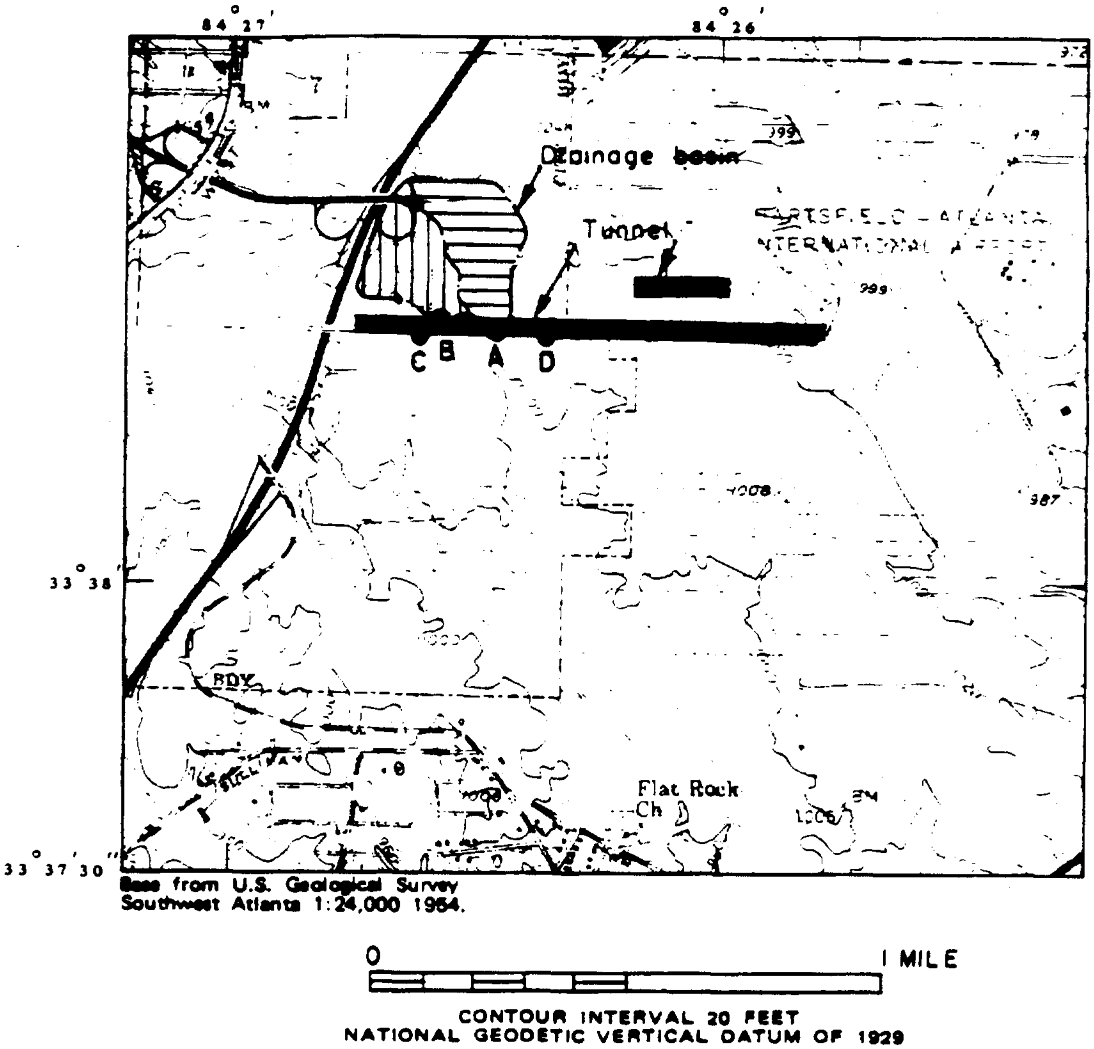


Figure 2. Well sites in the "people mover" tunnel area, Hartsfield-Atlanta International Airport. Sites A and B are downgradient from catchment areas supplying recharge; sites C and D are in interstream areas receiving little recharge.

water level in some observation wells declined more than a foot per day. Other wells responded slowly and showed little change in water level after 4 days of pumping. With continued pumping, however, the water levels in all observation wells declined, and by May 25, 1978, were drawn down to depths of 16 to 38 ft below land surface. By August 1978 the water level was generally in the range of 27 to 39 ft below land surface, well below the bottom of the construction ditch. The low water level kept the ditch free of seepage except immediately following heavy rains. This decline in water levels and the reduced yield of the few active wells, clearly indicated that ground-water storage in the saprolite largely had been depleted.

The monitoring of water levels also revealed that saprolite of layered rocks at the site (amphibolite, gneiss, and schist) has strong preferential permeability. Observation wells that had shown little response to nearby pumping wells located across the strike of the rocks immediately began drawing down with the start-up of wells along the strike. Preferential permeability in the saprolite of layered rocks (documented by Stewart, 1964) accounts for differing rates of drawdown that occurred during the dewatering operation.

The highest yielding well (70 gal/min at site A, fig. 2) penetrated interlayered schist, gneiss, and amphibolite and probably derived water from more than one interformational contact zone. Other wells in the 20-30 gal/min yield range (sites B, C, and D, fig. 2) penetrated interlayered schist, granite gneiss, and some amphibolite.

The dewatering operation demonstrated the importance of locating high-yielding wells in topographic settings that can supply recharge in quantities large enough to balance intended withdrawals. After months of pumping, only the wells in stream valleys downgradient from sizable catchment areas (sites A and B, fig. 2) continued to supply significant yields. Wells in interstream areas (sites C and D, fig. 2), on the other hand, where the quantity of recharge is limited, declined in yield and eventually were pumped dry.

The response of this well field to pumping was much the same as others in the GAR and adjacent areas of the Georgia Piedmont. Over the long term, wells tapping permeable contact zones or other types of permeable zones, no matter how large the initial yield, can supply water only at the rate it is replaced by recharge. Normally, the recharge needed to sustain high well yields for extended periods, and especially through prolonged droughts, is available only in stream valleys, drainages, and draws that receive constant recharge from large catchment areas, or in broad flat areas covered by deep saturated soil. <u>A leading cause of declining well yields in the report area is the practice of locating wells without regard to the adequacy of available recharge</u>. For this reason, successful methods for locating high-yielding well sites emphasize the importance of considering the adequacy of available recharge.

Fault Zones

Faults in the report area consist of two types: (1) large fault zones, such as the Brevard Zone (Unit G, plate 1), that have extensive rock deformation (cataclasis) and numerous small faults within the zones, and (2) faults that displace rock units without extensive deformation around the fault zone.

In large fault zones, shearing and deformation within the zone may reduce the overall permeability of some types of rock and increase the permeability of others. Limited data indicate that wells in broad lowland settings may be highly productive in the Brevard Zone. Owing to the small number of wells and to poor exposures in lowland areas, however, data are not available to indicate which lithologies within the Brevard Zone are the most productive.

Faults that displace rock units without extensive deformation may be highly permeable and supply large well yields. The largest yields generally are available from faults that involve both resistant rocks such as massive gneiss or granite (Units B and F) and less resistant rocks such as feldspathic schist (Unit C). Increases in permeability along these faults result from differential weathering of the contrasting rock types, much the same as occurs in permeable contact zones. Although fractures produced by movement on the faults typically have been healed by mineralization and no longer are fully open, the shearing and mixing of rock types contribute to increasing the permeability along the faults. A good example of a permeable fault zone is the one that extends from eastern Carrollton, Carroll County, southwestward more than 5 miles, involving schist (Unit C) and granite (Unit F). Several wells in the fault zone yield 20 to 80 gal/min.

Work in crystalline rocks in eastern Georgia by David C. Prowell (U.S. Geological Survey, oral commun., 1980) has shown that relatively recent faults are unmineralized and contain open fractures. The faults consist of one or more zones 10 to 30 ft wide in which the rock is broken by numerous vertical or nearly vertical fractures 1 to 4 inches apart. Between the individual fractures, the rock commonly is brecciated and the pieces are rotated at various angles. A 4- to 6-inch wide zone of fault gouge (rock flour) generally occurs near the middle of each fracture zone. The fractures in the fault zone are open and should be capable of storing and transmitting large volumes of ground water. Although no recent faults were recognized during the present study, they may be present in the GAR. Where they project into topographically low areas favoring increased recharge, recent faults should supply large well yields.

According to Prowell (U.S. Geological Survey, oral commun., 1980), except in fresh-rock exposures such as in deep road cuts and quarries, these recent faults are difficult to recognize. Their presence cannot be detected in the soil horizon, but relicts of breccia or variously oriented rock fragments may remain visible in saprolite. It is not known whether the faults would produce a surface trace recognizable as a topographic feature such as a lineament, but it seems likely that they might bring about noticeable changes in vegetative vigor. The likelihood of their producing lineaments probably would be greater in the north half of the area than in the south half.

Stress Relief Fractures

Water-bearing openings in crystalline rocks traditionally have been described as steeply inclined and "X"-shaped fractures and joints similar to those pictured in figure 3 (LeGrand, 1967, p. 6). These openings are reported to be most numerous and to have the largest water-bearing capacity near the surface and to become tighter and more widely spaced with increasing depth.

According to LeGrand (1967, p. 5), most of the interconnecting openings occur less than 150 ft below land surface and few extend deeper than 300 ft. Tradition also has held, as stated by LeGrand (1967, p. 1-2), that high-yielding wells are common where relatively low topographic areas and thick residual soils are combined, and low-yielding wells are common where hilltops and thin soils are combined. Accordingly, sites having the largest yield potential are assumed to be draws and valleys in or downgradient from large catchment areas having a deep soil cover. Sites having the lowest yield potential are narrow ridge tops and upland steep slopes having little, if any, soil cover.

From the beginning of this study, it was apparent that many high-yielding wells, particularly in the south half of the GAR, occupy topographic settings indicated by previous workers to have low

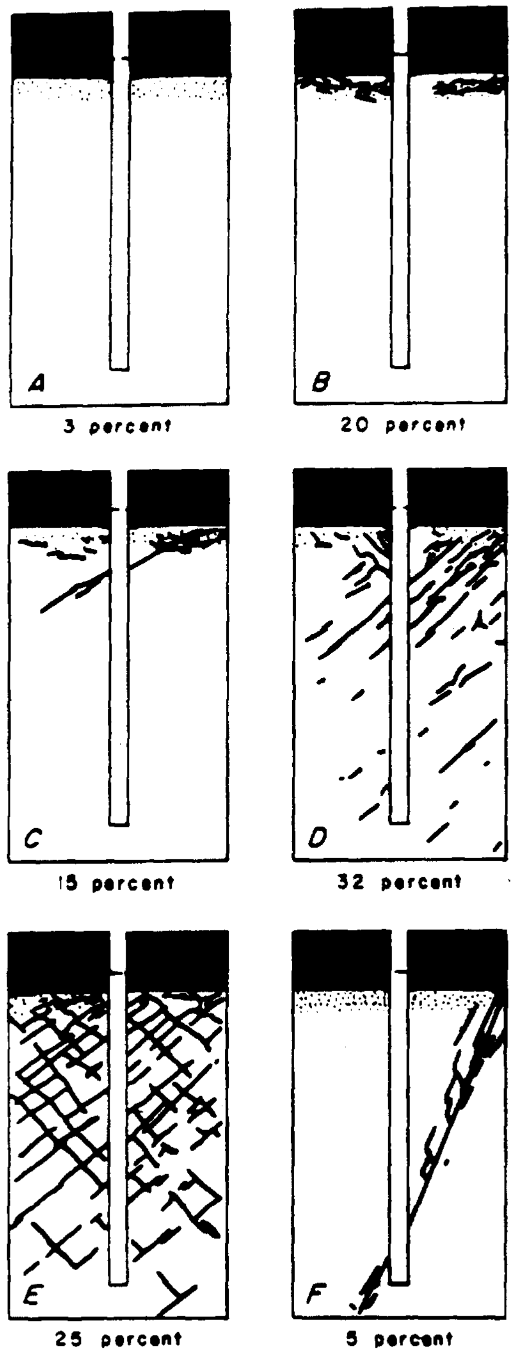


Figure 3. Six types of ground conditions showing distribution of fractures that influence the yields of wells. The stippled pattern represents soils and soft rock; the dashed line is the water table. The degree of frequency of the different types is shown in percentage. (LeGrand, 1967).

yield potential. These wells are o hilltops, ridge crests, and steep slopes and many are in areas that have extensiv rock outcrops and little or no soi cover. According to the statistical dat presented by LeGrand (1967, p. 3), suc sites should have only a slight chance o supplying large well yields. Moreover about 14 percent of the high-yieldin wells throughout the report area deriv water from depths of 400 ft or mor (table 9). Thus in the GAR, particularl in the south half of the area, a larg percentage of the high-yielding wells derive water from bedrock openings mor than 400 ft deep, which is a significan departure from the findings presented b LeGrand for wells in other crystallin rock areas.

Because of the inconsistancies betwee the occurrence of ground water in th GAR, especially in the south half of th area, and those reported from other crystalline rock areas, the authors decide to investigate the nature of water bearing openings that supply large wel yields. The intent was to identify whatever differences might exist betwee water-bearing openings in the GAR an those in other areas that could explai these inconsistencies.

Borehole Geophysical Logs

The most practical means available t study the nature of water-bearing openings in wells was borehole geophysica logs. A complete set of geophysical log was run by the U.S. Geological Surve Southeast Region logger on test well (8CC8) and 3 (9DD1). Logs also were ru on high-yielding municipal wells i Turin, Coweta County, and Demorest i Habersham County and Blairsville in Unio County northeast of the GAR. The result showed that the nature of bedrock openings could best be studied by using caliper and sonic televiewer logs. Calipe and sonic televiewer logs were run o five additional wells in different type of crystalline rocks and different topographic settings to learn more about the character of water-bearing openings.

The caliper log is a graph of well-bore diameter, and it is useful because it indicates fractures and other bedrock openings, and gives a general indication of the vertical dimension of each opening (fig. 4). By matching the caliper log with driller's records of where water entered the well, it generally is possible to identify water-bearing openings. However, the caliper log is unable to reveal details about the nature of the openings.

The sonic televiewer log makes possible the visual inspection of the entire well bore, providing detailed information about rock texture, foliation, and bedrock openings. The log is made by a geophysical probe transmitting a rotating sonic beam that reflects off the inside of the well bore and the walls of fractures and other openings. The reflected signal is electronically converted into visual images of the well bore, projected on a video screen, and photographed to provide a permanent record of the image. The photographs show variations in rock texture, layering, and foliation as shades of gray; and open fractures, deep voids, and eroded zones as areas of black (figs. 5 and 6). The images on the photographs are at a known vertical scale and are oriented with respect to north, providing a means for measuring the approximate height of openings, determining whether they are flat lying or inclined, and measuring the strike and dip of inclined features.

Televiewer logs revealed that water-bearing openings in high-yielding wells supplying 40 gal/min or more differed from what had been reported for crystalline rocks. The logs showed that in granitic gneiss and biotite gneiss and in quartz-mica schist, water-bearing openings consist of horizontal or nearly horizontal fractures 1 to 8 inches in vertical dimension and range in depth

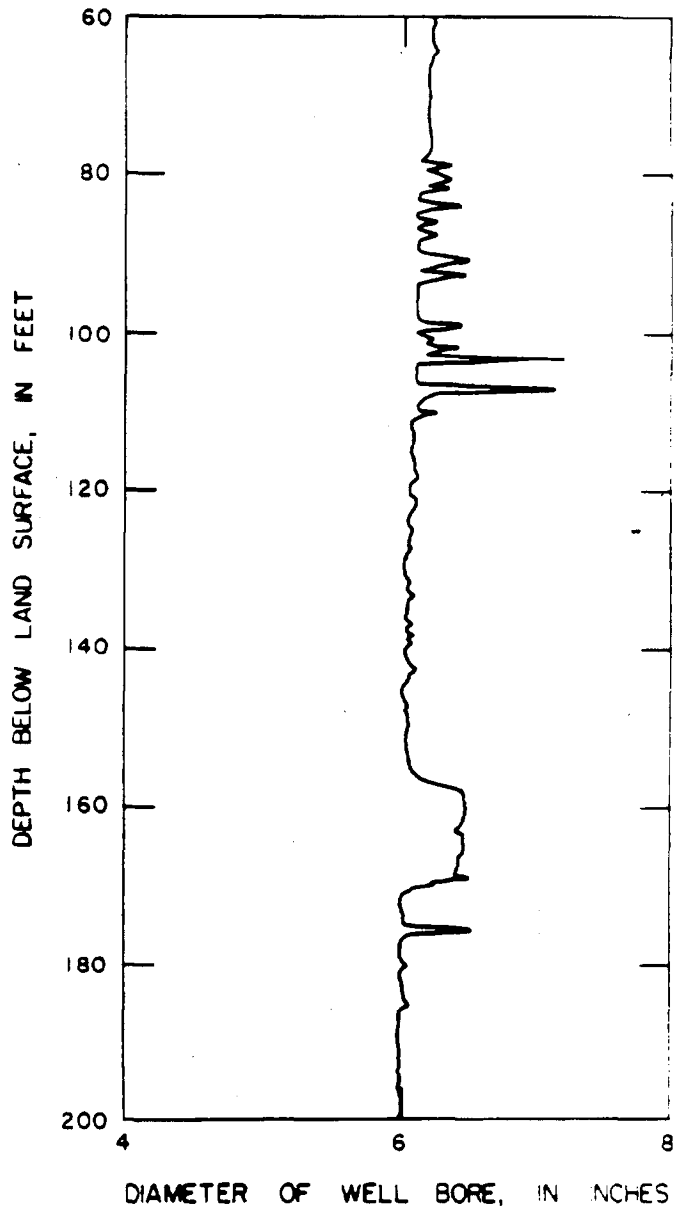


Figure 4. Caliper log of test well 2 (8CC8), Fulton County.

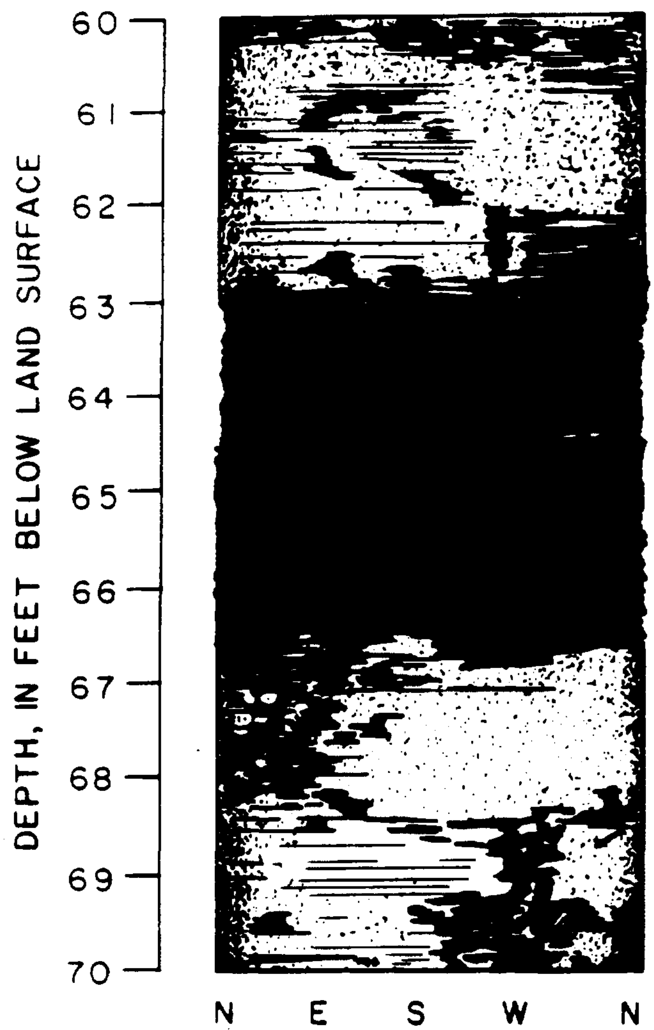


Figure 5. Televiewer image of water-bearing fracture and weathered zone eroded by drill, test well 3 (9DD1). Letters at bottom of image refer to compass quadrants.

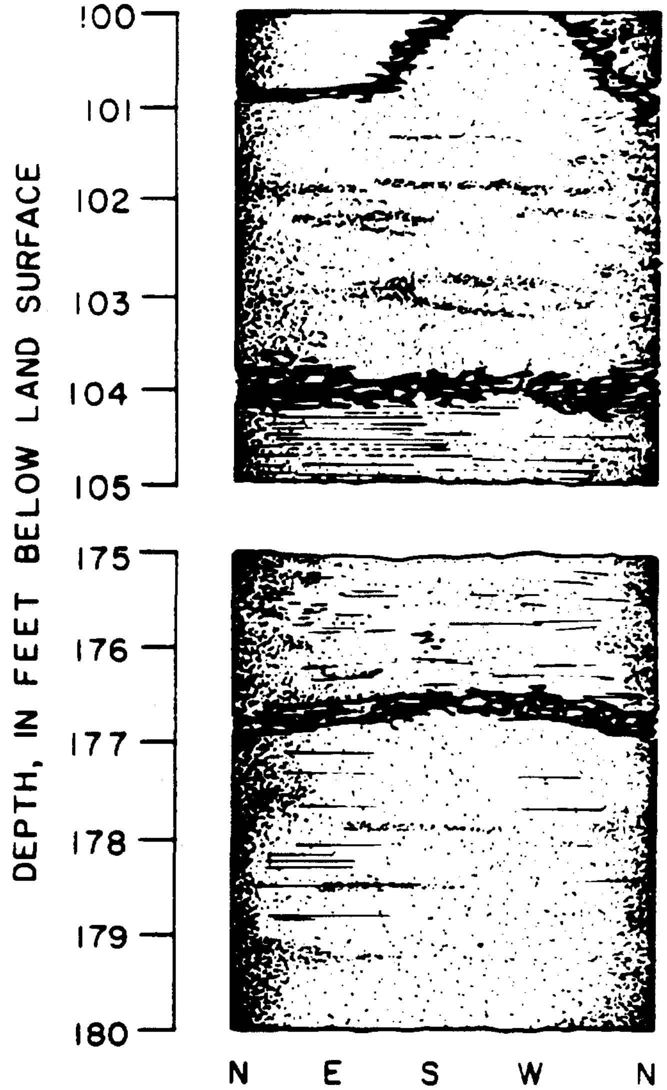


Figure 6. Televiewer image of non-water-bearing high-angle fracture at 100 feet, water-bearing horizontal fracture at 104 feet, and nearly horizontal water-bearing fracture at 176.5 feet, test well 2 (8CC8). Letters at bottom of image refer to compass quadrants.

from 28 to 440 ft. Water-bearing openings in multilayered rock units consisting of granitic and biotite gneiss interlayered with schist were shown to be horizontal fractures 1 to 3 inches in vertical dimension occurring in the gneiss layers.

Drill Cores

To verify that the televiewer logs were being correctly interpreted and to examine the surfaces of horizontal fractures for possible slickensides or other evidence of horizontal movement, the bedrock was core drilled at two well sites. The core drilling was done by the U.S. Geological Survey using a special triple tube core barrel to insure that all of the core would remain intact so that the extent of fracturing and the weathering of fracture surfaces could be properly evaluated.

During the coring process, changes in drilling rate, rotation pressure, and water pressure, which indicated the presence of openings in the rock, were precisely recorded relative to hole depth so that the exact vertical dimension of the void could be calculated. Accordingly, coring runs were exactly 10 ft in length and the amount of void space indicated by measuring the actual rock core was compared with the drilling records about the voids. These measurements of the void spaces were within 10 to 20 percent of each other.

One core, from the site of well 13DD-90, Rockdale County, penetrated granitic gneiss and confirmed that the horizontal fractures and the enlarged soft zones had been correctly identified and measured (fig. 7). The other core, from the site of test well 2 (8CC8), Fulton County, penetrated interlayered gneiss and schist and confirmed correct identification and measurements of horizontal fractures in that well. The core also revealed weathered foliation-plane openings, mostly at the contacts of schist and gneiss layers, that had not been recognized as openings in the televiewer pictures (fig. 8). No evidence of horizontal displacement was found on any surfaces of the openings.

The horizontal nature of the observed water-bearing fractures, the range of depths at which they occur, the types of topographic settings they underlie, and the rock types in which they are present, all suggest that the openings may be stress relief fractures (Wyrick and Borchers, 1981). The mechanism for forming horizontal stress relief fractures seems to be the upward expansion of the rock column in response to erosional unloading (Billings, 1955, p. 93; Wyrick and Borchers, 1981, p. 12), as shown in figure 9. The formation of stress relief fractures seems to be dependent on the volume of overburden removed relative to the area being eroded, as in a broad stream valley (fig. 28), or from the area adjacent to a ridge or upland area, as commonly occurs with divide ridges.

Stress relief fractures probably do not lie entirely along a horizontal plane, but are very low dome-shaped structures that in cross section would appear as low arches (fig. 10). The fractures probably are circular or elliptical in plan view, are slightly inclined near the outer edges, and have the maximum void space near the center. Televiewer pictures indicate that stress relief fractures an inch or so high (which could be near the outer edge of the fracture) are inclined about 5 degrees. The arching may produce vertical fractures that extend toward the surface, providing avenues of recharge. They also may serve to connect two or more stress relief fractures, thereby forming a network of interconnected fractures.

Horizontal stress relief fractures seem to occur mainly in large bodies of granitic and biotite gneiss (water-bearing Units B and D), but they also are important in units consisting of gneiss interlayered with schist (Unit A) and in schist (Unit C) and amphibolite (Unit E).

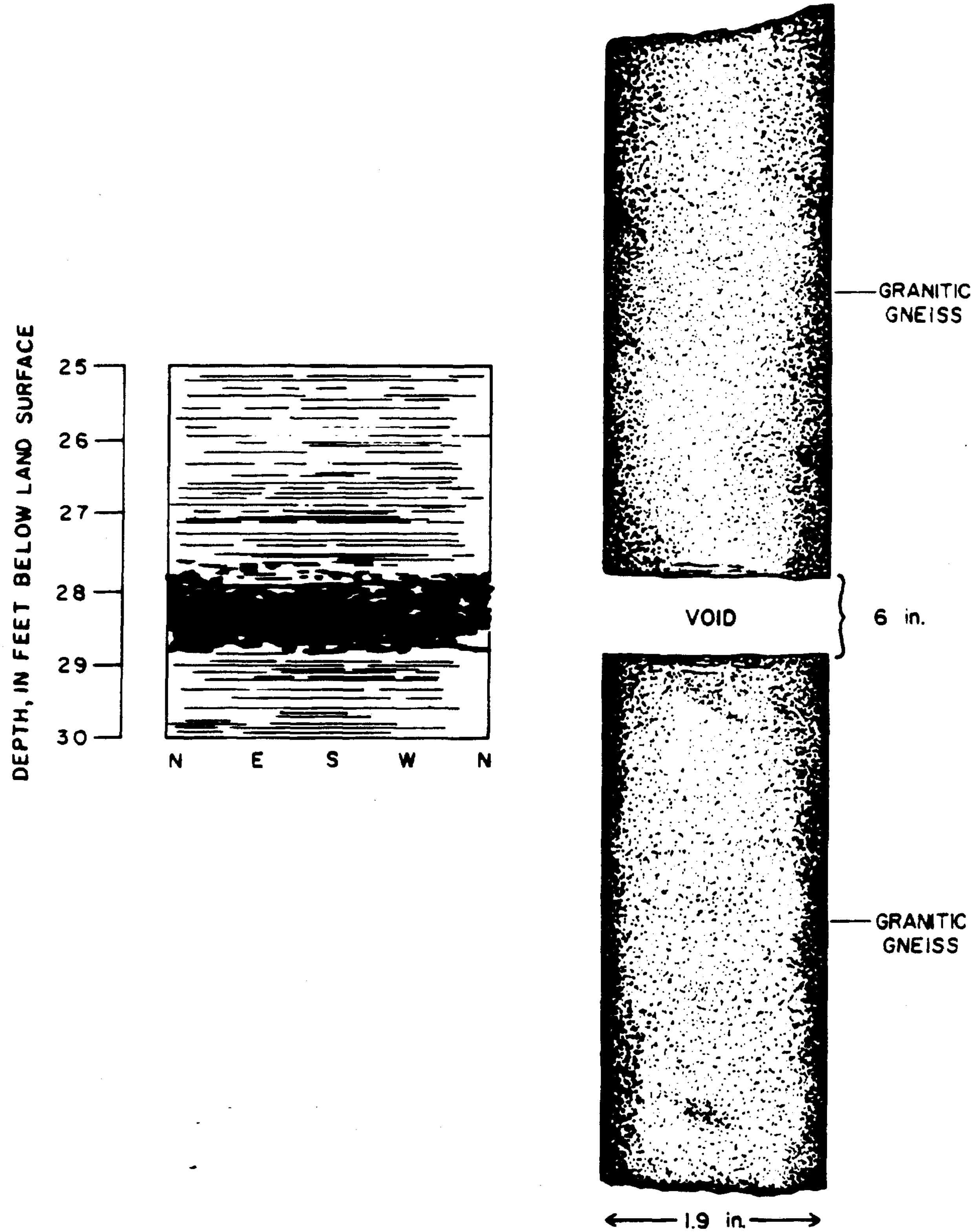


Figure 7. Comparison of televiewer image of horizontal water-bearing fracture with diagram of drill core, well 13DD90, Rockdale County.

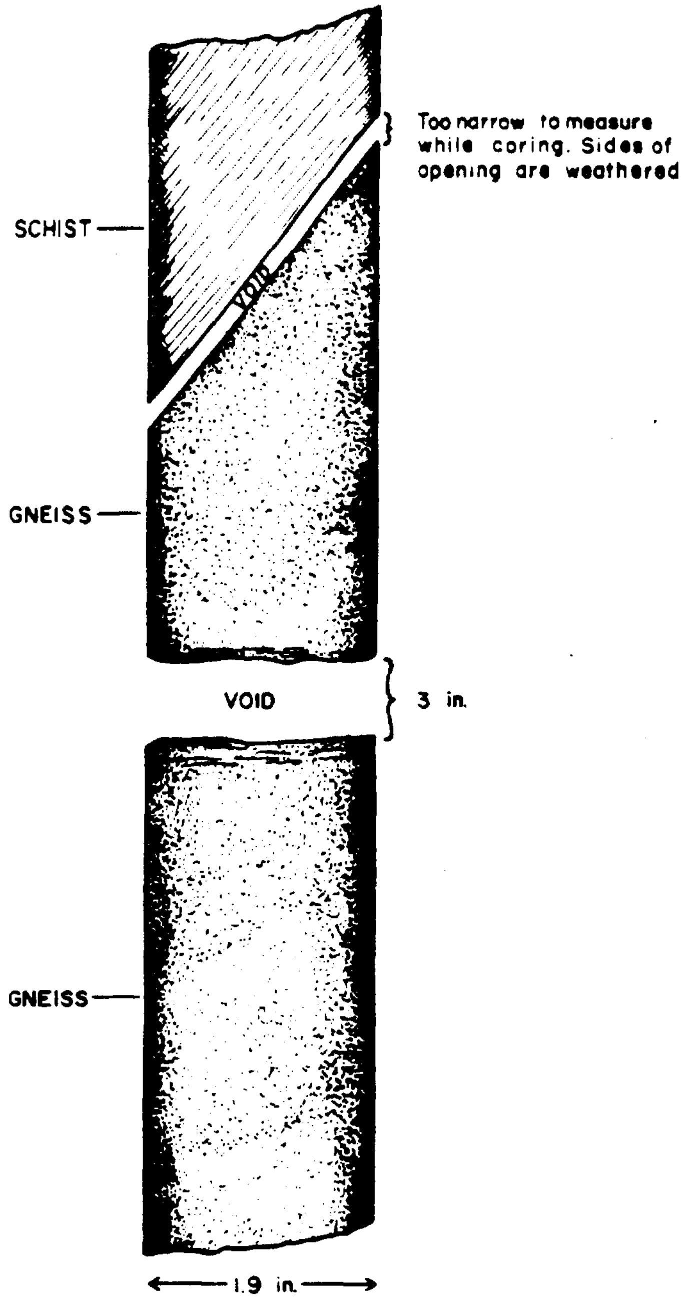


Figure 8. Diagram of drill core from test well 2 (8CC8), Fulton County, showing horizontal fracture in gneiss and opening parallel to foliation between schist and gneiss.

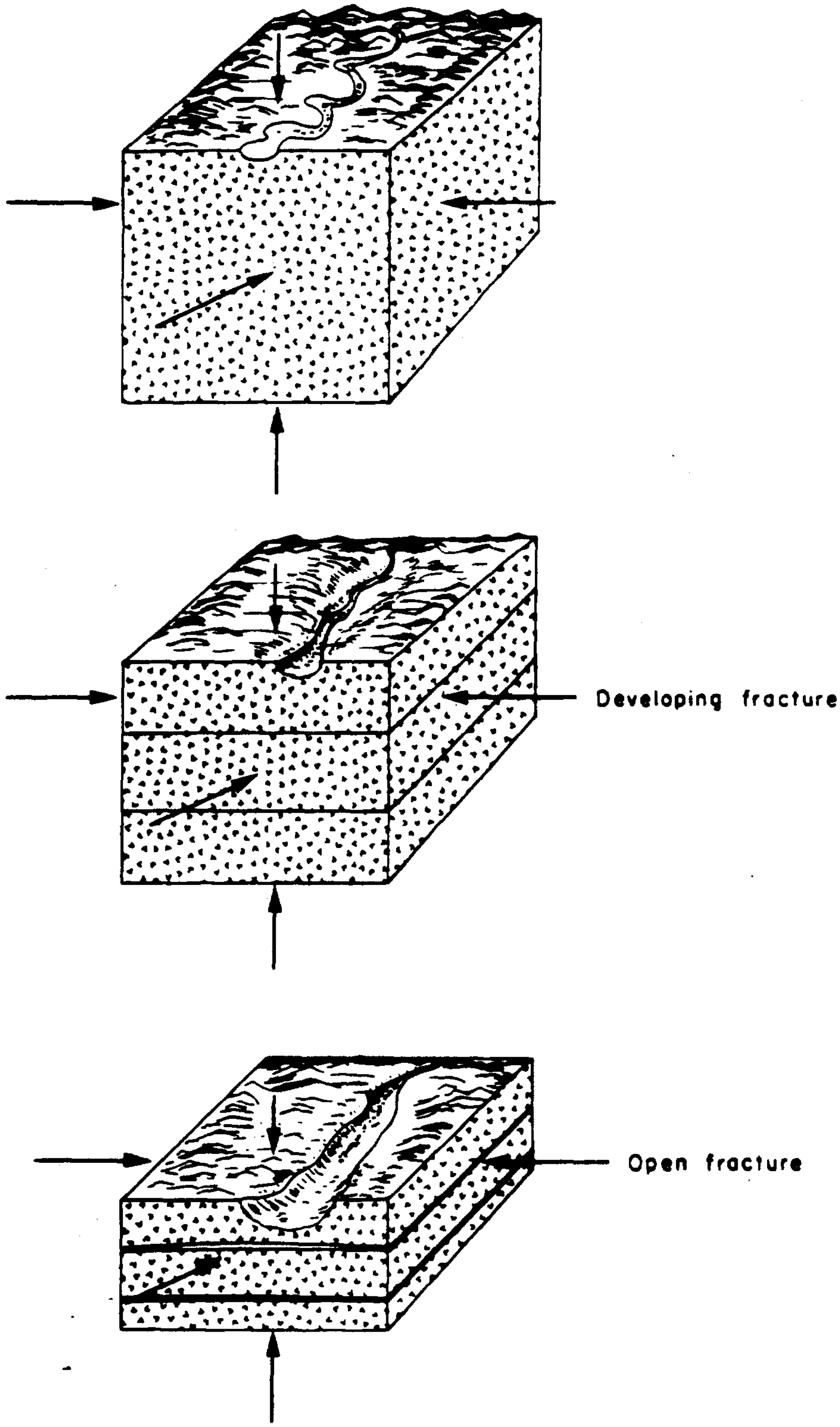


Figure 9. Stress relief fractures are believed to be caused by the upward expansion of the rock column in response to erosional unloading. Arrows represent the direction and their length represents strength of compressional stress.

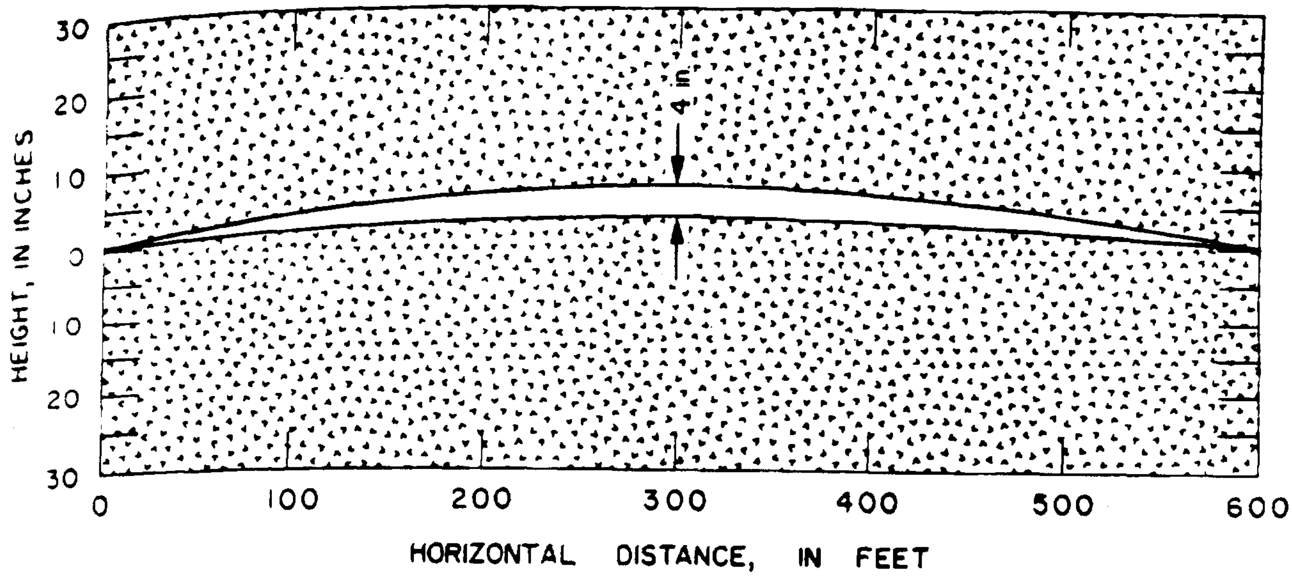


Figure 10. Hypothetical cross section of a stress relief fracture. The fractures probably are low arches that have the largest opening near the center.

Horizontal fractures probably form significant water-bearing openings in large bodies of gneiss in the south half of the area and possibly area-wide. Horizontal fractures were observed in one well (at Demorest, Habersham County, northeast of the GAR) in quartz-mica schist, and they may be a common occurrence in schist units having a high quartz content. Water-bearing stress relief fractures also may occur in granites, although none were identified during this study.

Bottom-Hole Fracture Wells

Driller's records show 25 wells in the report area that unquestionably derive large yields from openings at or near the bottom of the well. All of the wells share the characteristic of remaining dry, or essentially dry, during drilling until they penetrated one or two high-yielding fractures. The high-yielding fractures are at or near the bottom of wells because: (1) the large yields were in excess of the desired quantity and, therefore, drilling ceased, or (2) in deep wells yielding 50 to 100 gal/min or more the large volume of water from the fracture(s) "drowned out" the pneumatic hammers in the drill bits, effectively preventing deeper drilling. Four wells having identical characteristics were shown by sonic televiewer logs to derive water from horizontal fractures. Therefore, the writers believe that the bottom-hole fracture wells derive water from horizontal stress relief fractures.

Bottom-hole fracture wells are of particular interest because they include the highest-yielding wells in the study area. Construction data, topographic settings, and geology for 25 wells that derive water from bottom-hole fractures are given in table 4. The general locations of the wells are shown in figure 11.

In addition to the 25 wells listed in table 4, several other wells in the GAR share the characteristic of remaining nearly dry during drilling until they

Table 4.—Construction data, topographic setting, and water-bearing units of bottom-hole fracture wells

Well number	Water-bearing unit	Yield (gal/min)	Depth (ft)	Casing depth (ft)	Depth of water-bearing fracture (ft)	Topography
4CC2	C	100	328	—	325	Near head of large draw on slope of divide ridge.
7BB42	D	87	330	52	330	Near head of draw on divide ridge.
8AA10	A	200	352	85	320	Divide ridge surrounded by stream heads.
9CC18	A	30	405	50	110	Point of land.
9HH5	A	200	526	12	526	Do.
10AA9	A	200	175	—	—	Point of land projecting into stream valley and shear zone.
10CC11	B	100	160	18	150	Saddle on ridge at head of two draws.
10CC12	B	50	150	30	140	Point of land.
10EE5	D	110	450	27	443	Head of draw on ridge slope.
10EE29	C	100	430	50	430	Point of land projecting into flood plain.
10HH2	A,C	150	346	92	330	Broad point of land; at head of draw on ridge slope.
11CC8	A	40	345	56	335	Head of draw on ridge slope.
12BB5	A	100	105	55	65	Crest of broad ridge.
12CC14	B	150	146	126	140	Head of draw near crest of narrow ridge.
13CC58	A	100+	340	—	335	Point of land.
13DD55	B	120	550	34	540	Crest of divide ridge surrounded by steam heads.
13DD56	B	348	410	103	400	Head of draw on divide ridge surrounded by stream heads.
13DD69	B	172	435	25	430	Crest of divide ridge surrounded by stream heads.
13DD89	B	150	230	12	220	Do.
14CC14	A	34	200	10	173	Do.
14FF3	B	100	398	46	395	Ridge crest.
14FF7	E	254	265	54	250	Draw on ridge slope.
14FF8	E	471	302	30	290	Near head of draw on slope of divide ridge.
14FF9	E	400	352	40	340	Base of ridge in stream valley.
14FF10	E	270	386	20	330	Stream valley.

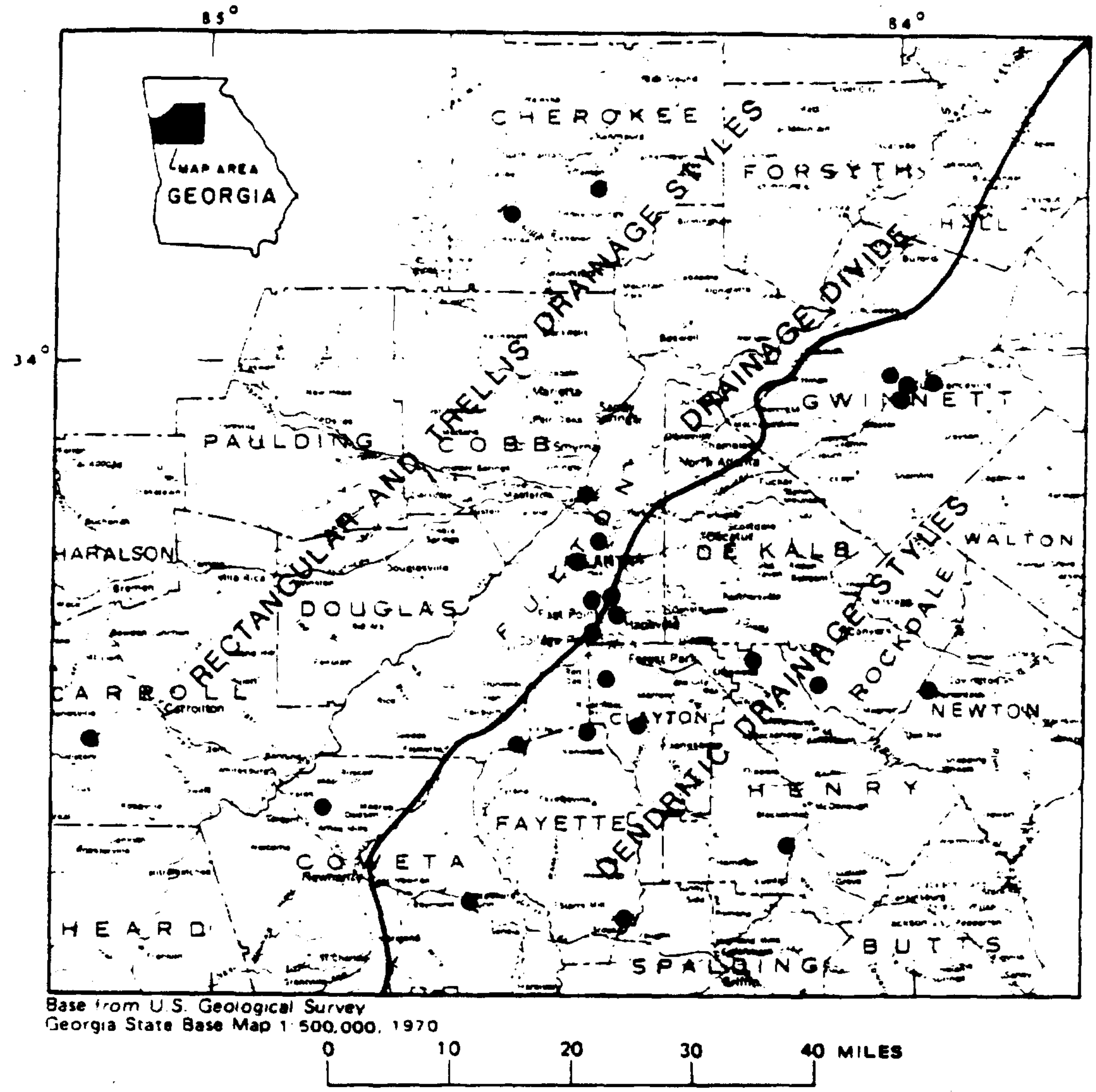


Figure 11. Locations of bottom-hole fracture wells.

obtained a large yield from one or two openings at depth. According to the memories of their owners and drillers, these wells derived their entire yields from one or two openings at or very near the bottom of the holes. The writers believe these wells also are bottom-hole fracture wells that derive water from stress relief fractures, but they were omitted from the table because no written records of the wells were available.

Areal Extent of Stress Relief Fractures

No practical means was found to measure the areal extent of stress relief fractures. Conyers well 13DD56, which is 410 ft deep and supplies 348 gal/min, is known to be connected with a 470-foot deep residential well about 400 ft to the north-northeast. The connection between the two wells was discovered when compressed air used to drill the residential well began escaping from the Conyers well.

Well 13DD90, about 2 miles southwest of Conyers, which derives water from horizontal fractures, is affected by wells 300 and 600 ft to the south, and seems to interfere with a well about 1,000 ft to the west. Conyers wells 13DD54 and 13DD55, on the other hand, are about 1,500 ft apart and tap separate horizontal fractures.

The spacing of these and other wells indicates that horizontal stress relief fractures probably range from as little as 100 ft to more than 1,000 ft across. The areal extent of individual fractures may be controlled by rock type, the size of the rock body, the geologic structure, and the amount of overburden removed relative to the area of the fracture.

Locating Horizontal Stress Relief Fractures

Because of their horizontal nature the fact that they occur mainly at dep of 150 to more than 600 ft, stress rel fractures are not revealed by structu and stratigraphic features norma associated with increased bedrock per ability. The only clue to their pr ence, recognized thus far, is topograp setting. Although wells tapping horiz tal fractures occupy a variety of to graphic settings ranging from ri crests to broad stream valleys, a la percentage of the wells occur in th rather distinct types of topographic s tings. A knowledge of these settings aid in selecting sites for high-yield wells in areas having horizon fractures.

The types of topographic settings a

A. Points of land formed by (1) streams converging at acute angles (f 12B, C), (2) two subparallel tributar entering a large stream (fig. 12A, and (3) land protruding into the w flood plains of large streams (fig. 12 In 1 and 2, the points of land genera are less than 2,000 ft across.

B. Broad, relatively flat ri areas, commonly on divide ridges, t are surrounded by stream heads (figs. and 14). The wells are on the ri crests and in the upper reaches streams flowing off the ridges. S areas are the sites of many towns communities and, therefore, are cent of municipal and industrial pumpage.

C. Broad valleys formed by the moval of large volumes of material re tive to the land on either side (f 28).

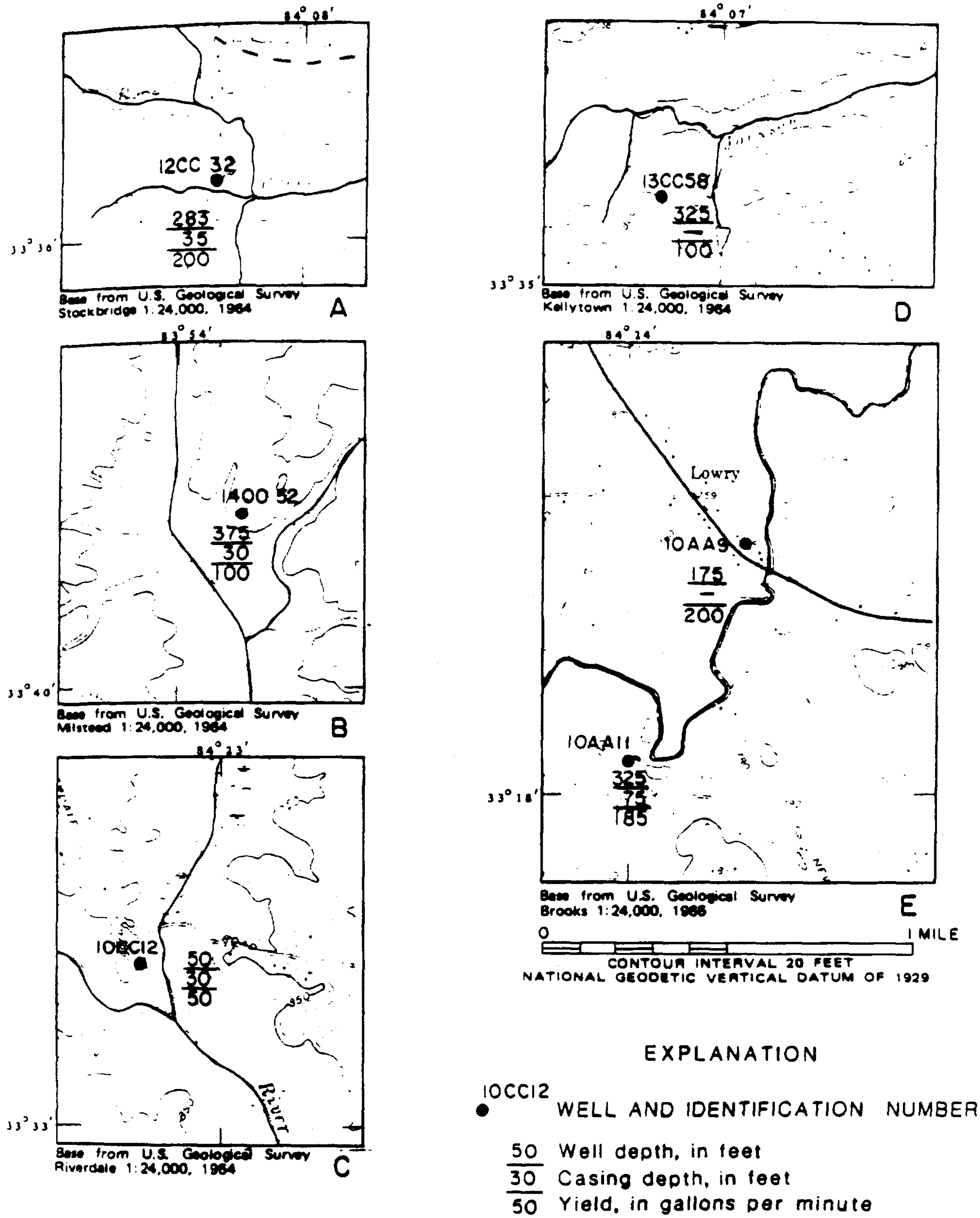
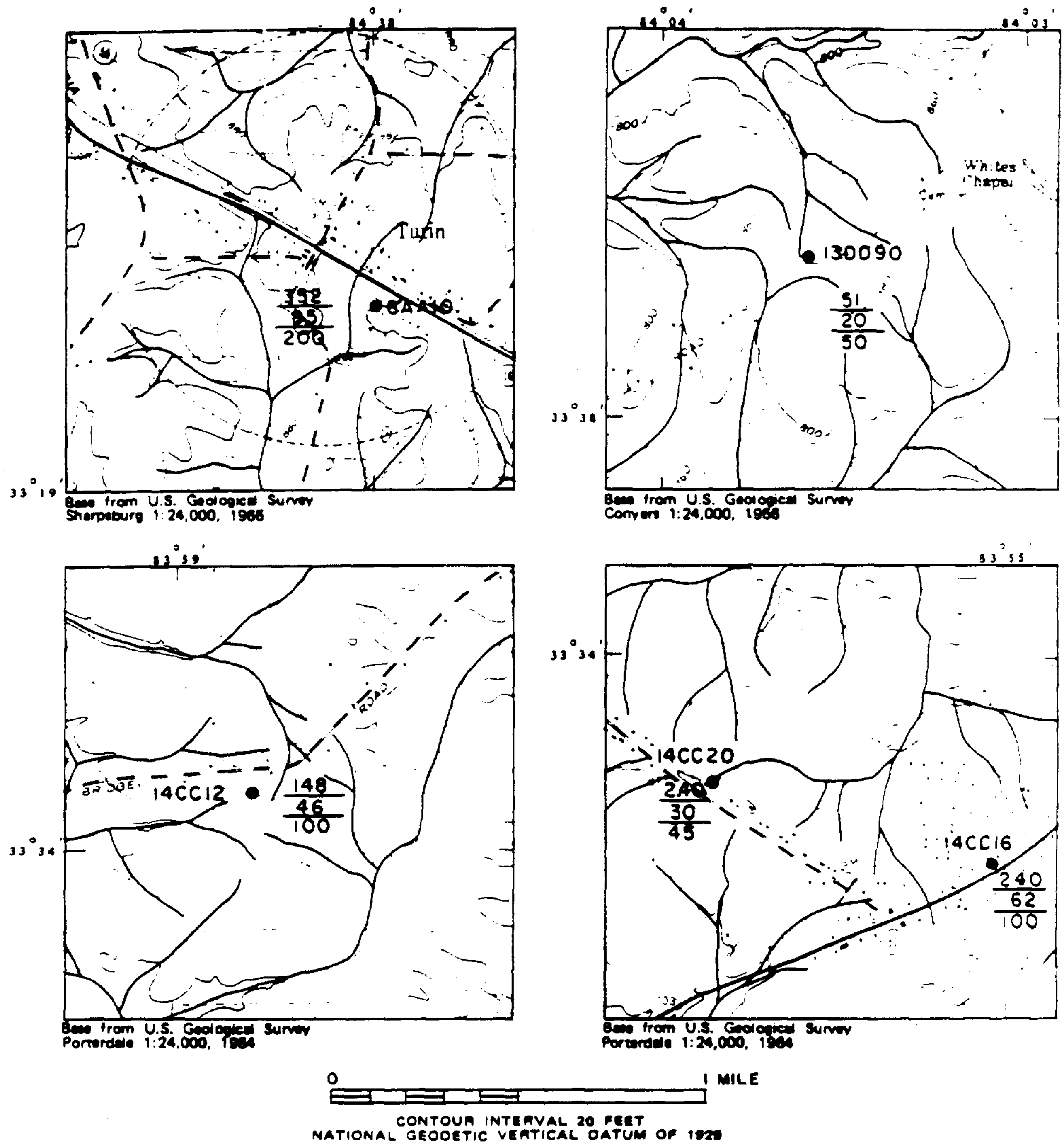


Figure 12. Wells tapping horizontal fractures commonly occupy points of land formed by confluent streams or projections of land that form constrictions in the broad flood plains of large streams.

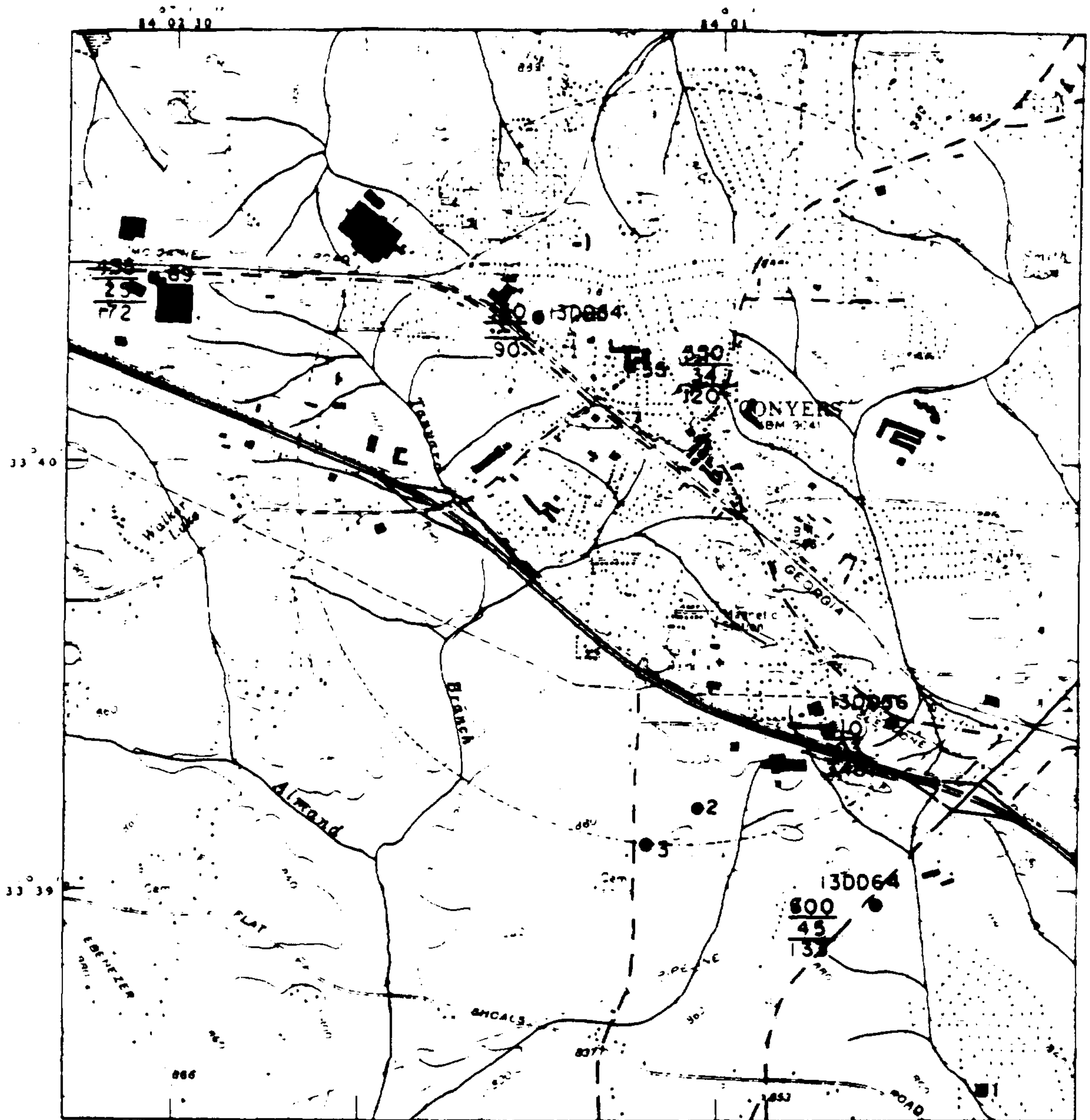


EXPLANATION

●14CC16 WELL AND IDENTIFICATION NUMBER

240 Well depth, in feet
62 Casing depth, in feet
100 Yield, in gallons per minute

Figure 13. High-yielding wells commonly tap horizontal fractures on ridges and u
land areas surrounded by stream heads.



Base from U.S. Geological Survey
Conyers 1:24,000, 1968

0 — 1 MILE

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

● 13D064 WELL AND IDENTIFICATION NUMBER

600 Well depth, in feet
45 Casing depth, in feet
133 Yield, in gallons per minute

Figure 14. Wells tapping horizontal fractures commonly are on divide ridges surrounded by stream heads or in the upper reaches of streams flowing off divide ridges, as in the Conyers area, Rockdale County. Wells 1, 2, and 3, each 600 feet deep, are dry.

Zones of Fracture Concentration

Aquifers of low to moderate productivity may yield large quantities of water to wells from localized zones of increased porosity and permeability created by the concentration of fractures. These zones of fracture concentration generally are between 30 and 200 ft wide, along which the bedrock is shattered to an indefinite depth by numerous, nearly vertical, closely spaced fractures or faults of small displacement that are alined approximately parallel to the long axis of the fracture zone (fig. 15). The zones of fracture concentration extend in straight or slightly curved lines that range in length from a few hundred feet to several miles. Straight or slightly curved linear features a mile or more long, associated with these fracture zones, are visible on aerial photographs and topographic maps and are known as lineaments; shorter features are called linears.

Zones of fracture concentration tend to localize valley development. Rock weathering is greatest along these f ture zones because they transmit l quantities of moving water. The creased chemical weathering, coupled the erosive action of surface wa localizes the valleys over these fra zones (fig. 16). The chances of obt ing a high-yielding well are good in floors of valleys developed over a f ture zone (Parizek, 1971, p. 28-56).

Valleys developed over fracture z commonly possess distinctive characte tics that make them recognizable on graphic maps, aerial photographs, satellite imagery. Among the feat most easily recognized are: (1) str stream and valley segments, (2) abr angular changes in valley alinement, (3) alinement of gullies, small dep sions, or sinkholes (in marble).

In the GAR, zones of fracture con tration have localized valley develo mainly in the north part of the where topographic features devel

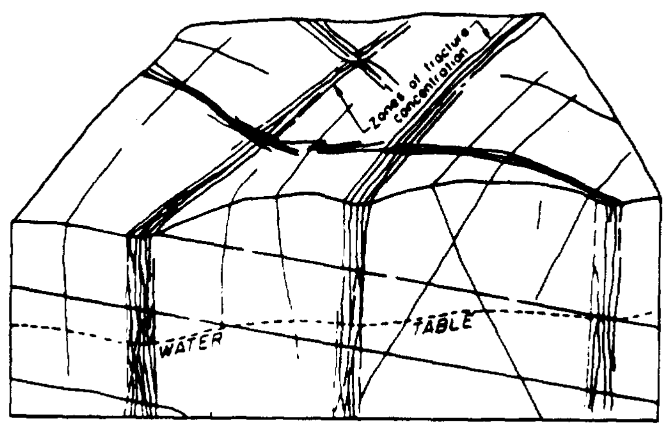


Figure 15. Zones of fracture concentration consist of nearly vertical closely spaced fractures. Modified from Parizek (1971).

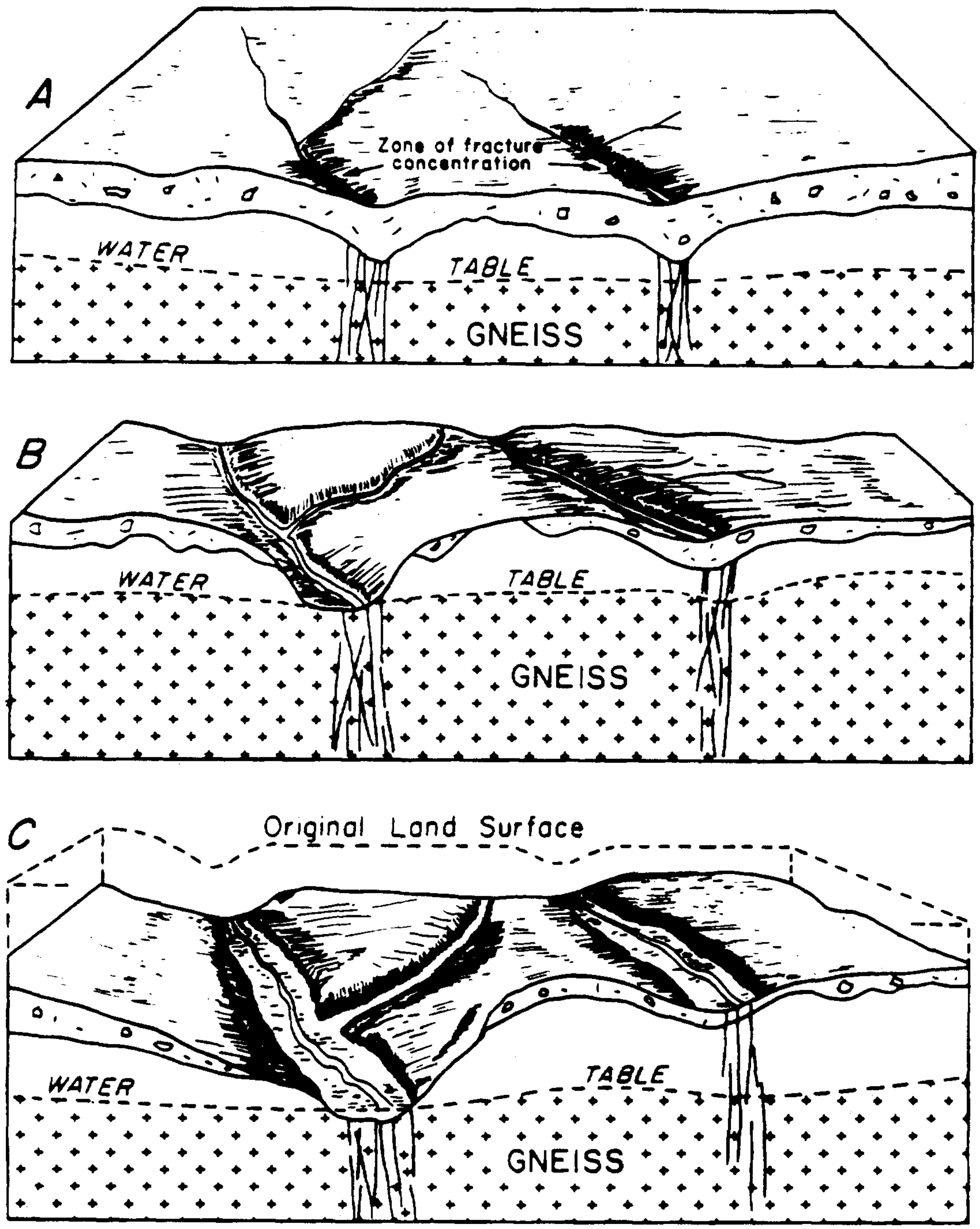


Figure 16. Valley development localized along zones of fracture concentration. Modified from Parizek (1971).

under geologic control. Several high-yielding wells in the north part of the area occupy sites on the floors of straight stream valleys that seem to have developed over fracture zones.

For example, the water supply for the Lake Arrowhead resort community, in northwest Cherokee County, was successfully developed in rugged terrain characterized by generally low-yielding wells, by drilling into zones of fracture concentration. Six production wells that penetrate zones of fracture concentration supply a combined total yield of about 560 gal/min. Driller's logs revealed that all of the wells having yields between 50 and 200 gal/min penetrated sizable fracture systems consisting of one or more large fractures or zones of closely spaced fractures. The largest yields came from zones of closely spaced fractures.

All the high-yielding wells occupy sites along straight stream segments, or where valleys make abrupt, angular changes in direction. Figure 17 is a map of part of the Lake Arrowhead area showing the locations of high-yielding and low-yielding wells, to illustrate how yields relate to topographic settings. All of the high-yielding wells are in settings that strongly suggest the presence of zones of fracture concentration.

As most zones of fracture concentration are rather narrow—30 to 200 ft wide --precision in locating wells was required to insure penetration of the water-bearing fractures. For example, wells 9JJ6 and 9JJ8 penetrated a fracture zone and yielded 80 and 200 gal/min, whereas well 9JJ12, which is situated slightly off the fracture zone, penetrated mainly solid rock and yielded only 13 gal/min.

Valleys possessing the distinctive characteristics of those developed over zones of fracture concentration--straight stream and valley segments; abrupt, angular changes in valley alinement; and alinement of gulleys, small depressi and gaps in ridges--are common in north part of the GAR. Many of th features overlie permeable fracture z and may be capable of supplying la yields to wells. For example, we 11GG11 and 11GG12 in Forsyth County supply 200 gal/min from a fracture in amphibolite of water-bearing Uni The fracture zone, which runs at nea right angles to the strike of the r underlies two straight stream segm that are alined with a gap in the in vening ridge (fig. 18). Numer straight stream segments of similar c acter occur in the north part of the and may supply large quantities of wa to wells.

Field investigations showed, howe that not all linear features in the n part of the area overlie permeable fr ture zones. Several straight stream valley segments in the Sweetwater C area of Douglas County were found to on rock having an average spacing joints and fractures. None of the leys was found to be associated wi zone of fracture concentration. Pos bly, these valleys were localized fracture zones that subsequently er away, leaving rock of average permeab ity. Depending on the depth of s cover and the amount of rock exposed, may not be possible to verify the pr ence of concentrated fractures by fi examination.

Zones of fracture concentration a occur in the south half of the area, all that were identified in the fi occupied hills and ridges and were associated with valley development. superimposed dendritic drainage in t part of the area seems to have grea limited the localization of valleys zones of fracture concentration. Val localized over fracture zones may be ited to the headwaters areas of drain where stream courses, draws, and ot depressions were formed after removal any preexisting cover and drainages w established under geologic control.

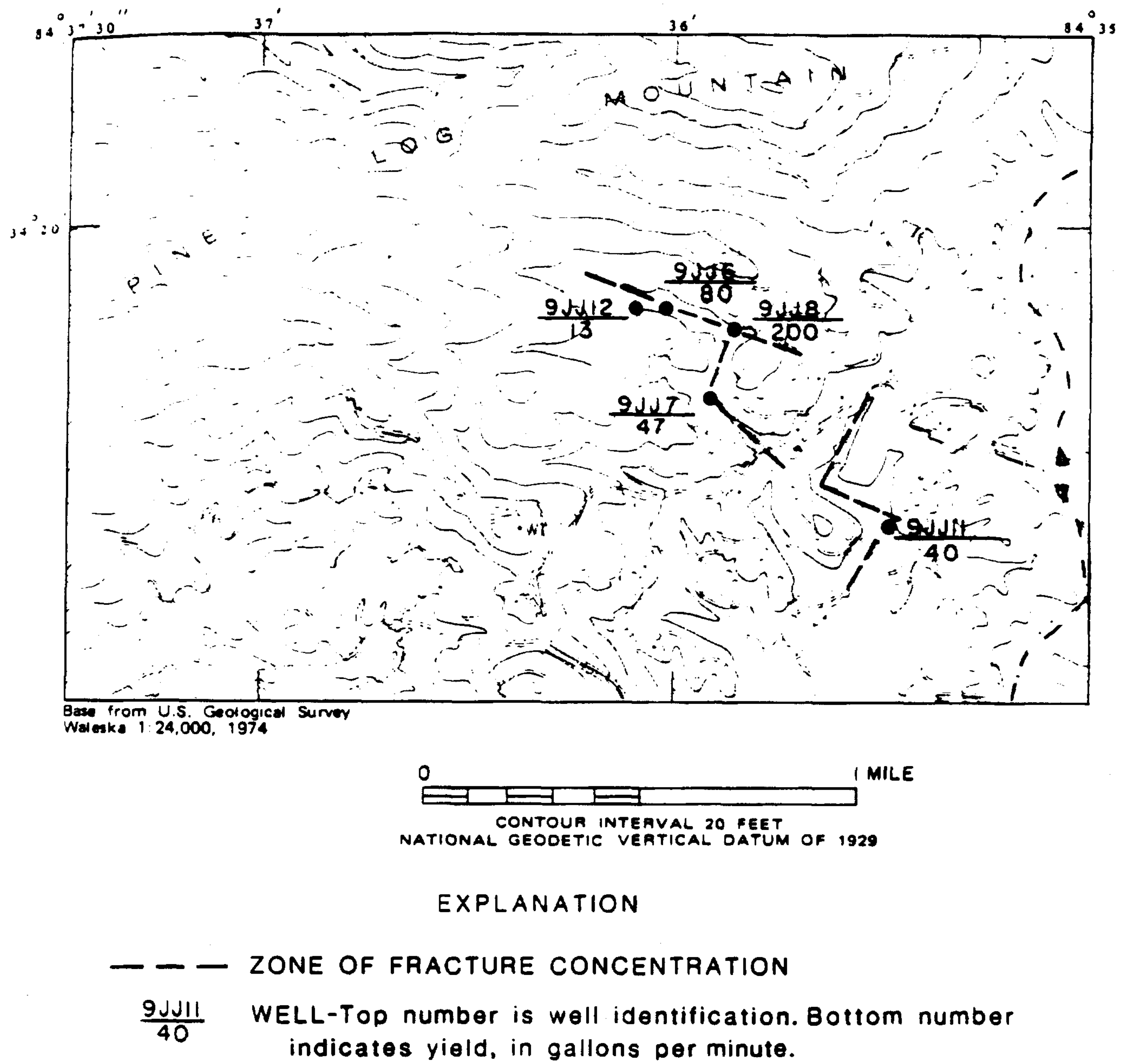
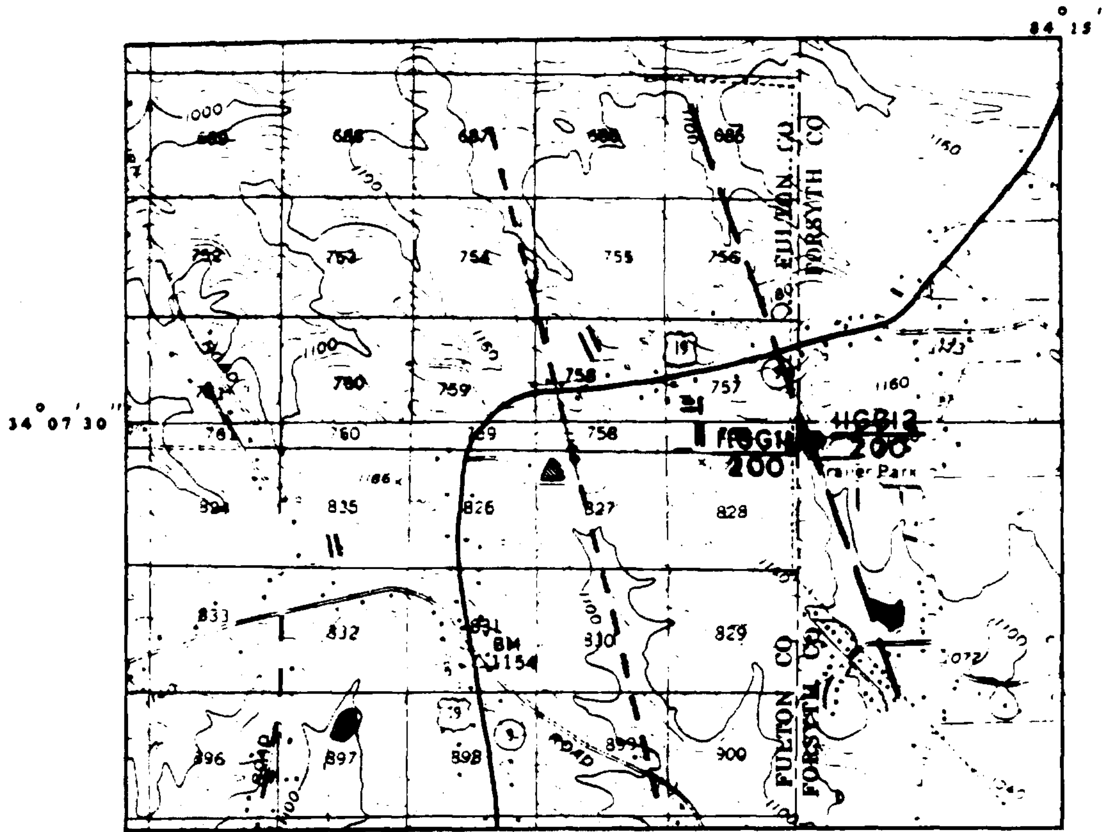


Figure 17. Relation of zones of fracture concentration to well yields, Lake Arrowhead area, Cherokee County. Modified from Cressler and others (1979).



Base from U.S. Geological Survey
Birmingham 1:24,000, 1956

0 — 1 MILE

CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

—— —— ZONE OF FRACTURE CONCENTRATION

— — — — PROBABLE ZONE OF FRACTURE CONCENTRATION

● $\frac{11GG11}{200}$ WELL-Top number is well identification. Bottom number indicates yield, in gallons per minute.

Figure 18. Permeable zones of fracture concentration commonly lie along straight valley segments that aline with gaps in ridges.

may explain why most high-yielding wells in the south part of the area that occupy valley settings are in headwaters areas.

Early in the study the writers observed that many straight stream and valley segments in the south half of the area have a persistent strike of N. 35°-40° W. Near Milstead in Rockdale County, several linear valleys having this strike are coincident with or closely associated with diabase dikes. Southwest of Atlanta, between Forest Park and Newnan, several straight stream and valley segments also strike N. 35°-40° W., but are not associated with diabase dikes. Because of their nearly identical strike with the dikes, the writers considered the possibility that these valley segments could have developed along the same system of tension joints that was intruded by the diabase to the east and, therefore, could overlie zones of increased permeability. A test well was drilled in a linear valley formed by a segment of Camp Creek south of Riverdale, Clayton County (fig. 19), to check bedrock permeability. The well, which is 600 ft deep, penetrated nearly solid gneiss and schist (Unit A) and yielded less than 10 gal/min. The results of this test provided the first hard evidence that these linear valleys were not localized over zones of fracture concentration and that their common strike was not a product of geologic control. This raised the question: could the parallel streams in the area having a common strike be a product of dendritic drainage?

In an attempt to answer this question, topographic maps of parts of the Georgia Coastal Plain were examined to see whether in other areas of dendritic drainage, streams assume parallel courses and maintain a similar strike over large areas. The maps showed that in the Coastal Plain, streams have a common tendency to form several straight valley segments that follow essentially parallel courses. Thus, the parallelism of several straight valley segments in the south half of the GAR seems to be a normal development of dentritic drainage style and may not be related to bedrock permeability.

Small-Scale Structures that Localize Drainage Development

Small-scale structures that localize drainage development play a major role in determining the availability of ground water. The structures include joints, bedding or compositional layering, foliation, cleavage, and the axial planes of small folds. Such structures represent inhomogeneity in rocks and form planes of weakness that enhance the rapidity and depth of weathering, bringing about increases in permeability.

Rocks generally are more permeable in directions parallel to these structures than across them. Preferential permeability in weathered schists and foliated rocks has been documented by Stewart (1964) and was observed during this study. (See section on contact zones under "Availability", this report.) As rocks weather, water moves through planar openings and establishes paths of circulation that increase the rate and depth of weathering. Weathering progresses rapidly and deeply along planes of bedrock weakness, tending to localize drainage development in much the same way as discussed for zones of fracture concentration.

Where small-scale structures underlie and trend parallel to stream valleys, drainages, and draws that concentrate the flow of water, they can be avenues of greatly increased permeability. Wells drilled into drainages that flow parallel to structural features in the underlying bedrock commonly supply large yields. Relating small-scale structures to the topography and drainage is a very successful method of selecting high-yielding well sites.

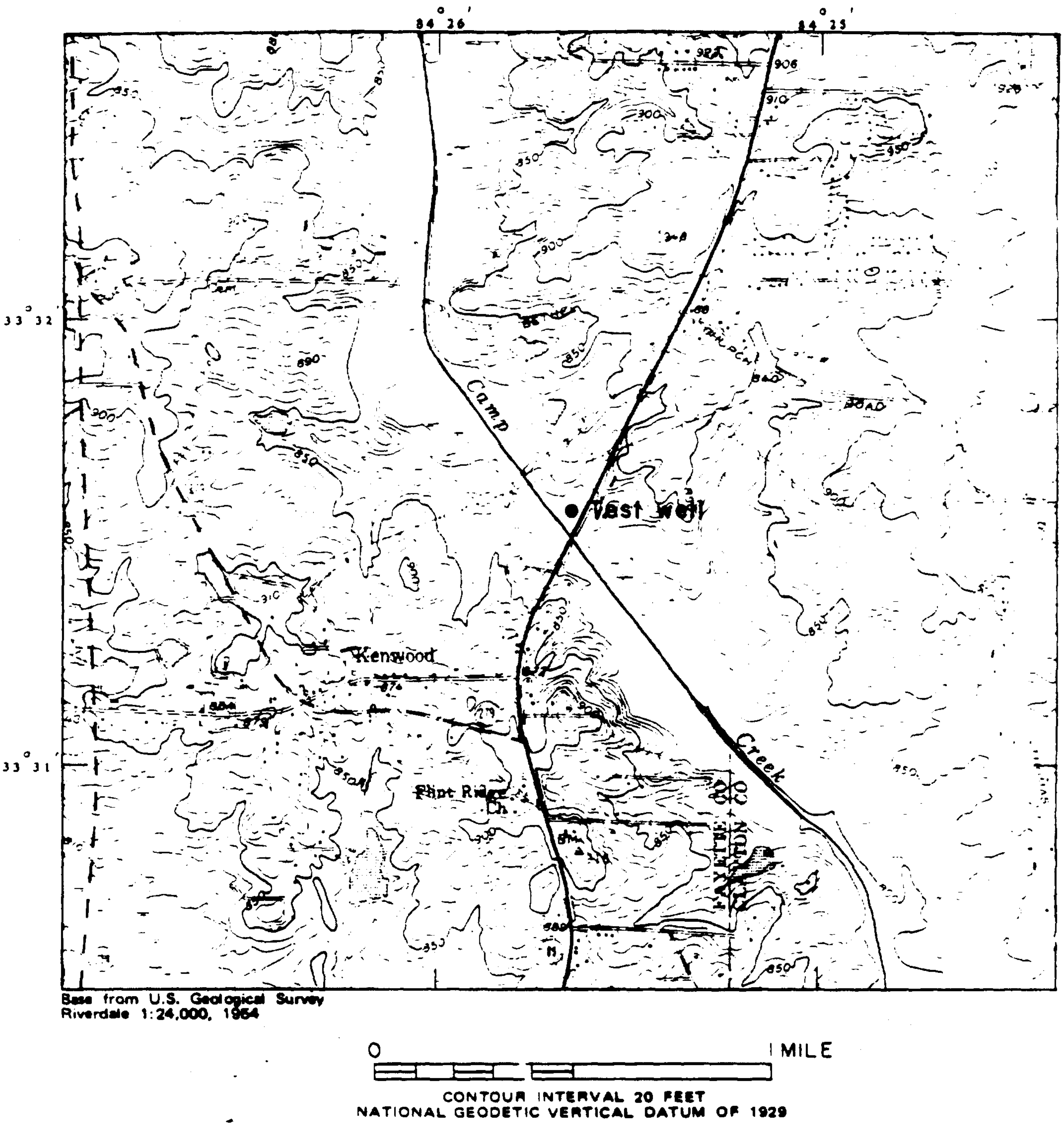


Figure 19. Topographic setting of the test well drilled in the linear valley formed by a segment of Camp Creek south of Riverdale, Clayton County.

Because small-scale structural features must localize drainage development in order to bring about significant increases in permeability, they are most useful in the north half of the report area where streams have developed under geologic control. They also may be useful in headwaters areas in the south.

In the south half of the report area, some high-yielding wells are obtained by drilling in small draws and drainages in the headwaters areas of large streams. Commonly, where wells on hilltops and ridge crests furnished insufficient yields, successful wells resulted from moving to sites in the nearest draw or headwater drainage. Because these uppermost drainages formed after removal of any preexisting cover, their locations have been influenced by the underlying bedrock structure and, therefore, they occupy relatively permeable zones.

Folds

Rocks in the GAR were too ductile during periods of major deformation to develop open joints. The latest two fold sets, however, occurred after the rocks cooled and were under less pressure, producing open joints that are concentrated along the fold axes (Michael W. Higgins, U.S. Geological Survey, oral commun., 1981). The folds, which are east-west and north-south trending open folds ranging from less than 75 to more than 600 ft across, are recognizable in road cuts and quarries (fig. 20), from where they can be projected into low areas favoring deep weathering and increased recharge. In the absence of more productive features, concentrations of joints along fold axes in the right topographic settings may be capable of supplying large well yields.

Shear Zones

The Geologic Map of Georgia (Georgia Geological Survey, 1976) shows a number of major shear zones south and southeast of Atlanta, in northern Spalding County and in Rockdale, Newton, and Walton Counties (plate 1). In relating well locations and yields to geology and structure, some of the highest yielding wells (100 gal/min to more than 200 gal/min) were found to be in these and other shear zones. Driller's logs of some of these wells report "broken rock" and "flint rock" in the wells, indicating that the wells penetrate shear zones. Other high-yielding wells are near shear zones and also penetrate permeable rock, although details about the type of rock penetrated were unavailable.

Many of the shear zones strike northeast and dip steeply to the southeast. They vary in length from less than 1 mile to about 7 miles. Although the geologic map shows shear zones to be continuous, field observations indicate that the longer shears may consist of a series of discontinuous zones that trend nearly parallel. The shear zones form prominent topographic lineaments and linears, generally consisting of low, narrow ridges flanking long, fairly straight valleys. The lineaments can be traced for miles in the field and are readily visible on topographic maps. Thicknesses of the shear zones are unknown, but the width of the associated valleys indicates that they may be as much as several hundred feet thick.

The shear zones occur in a variety of rock types, though most are in granitic gneiss (Unit B). The sheared rock consists of two types: flinty crush rock and sheared country rock.

The flinty crush rock is light-tan or buff colored, is very fine grained to cryptocrystalline, and breaks into small angular blocks. In hand samples it is easily distinguished from vein quartz. The more intensely sheared flinty crush rock weathers to small, flat, diamond-shaped pieces produced by intersecting shear planes. This is the single most consistent feature found in nearly all of the shear zones. Buff-colored flinty crush rock most commonly is associated with felsic granites and granitic

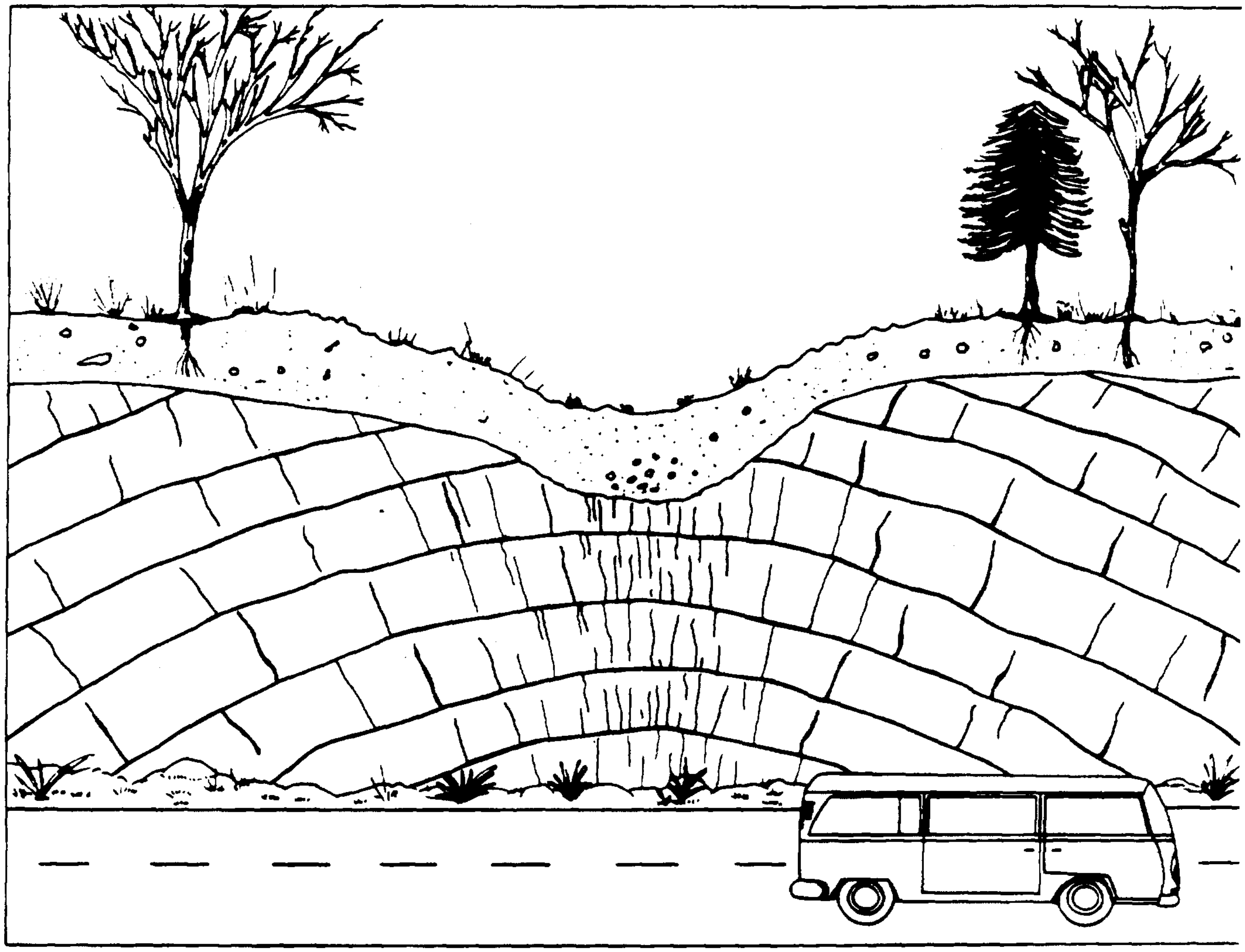


Figure 20. Concentrated jointing along the axis of a late fold.

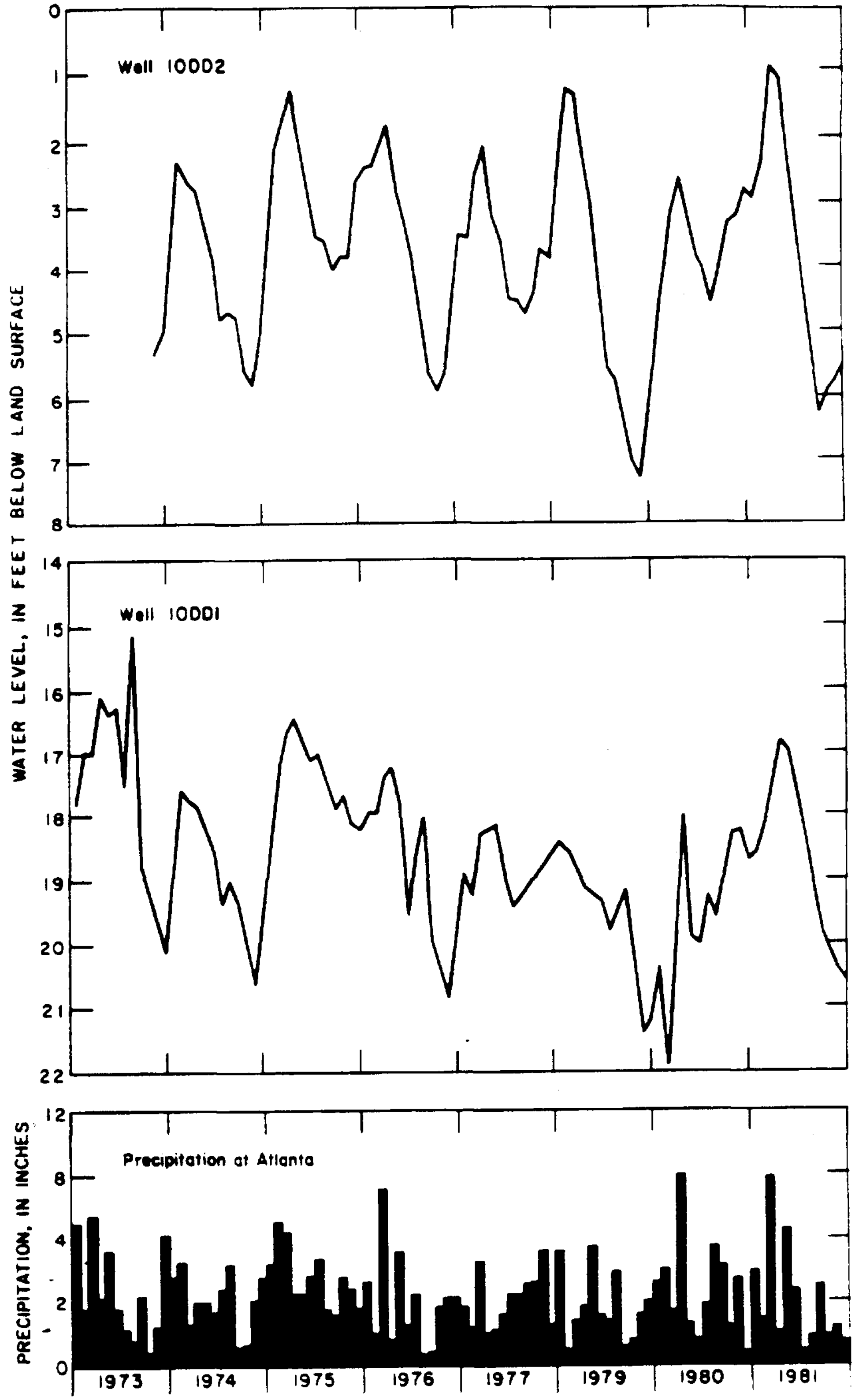
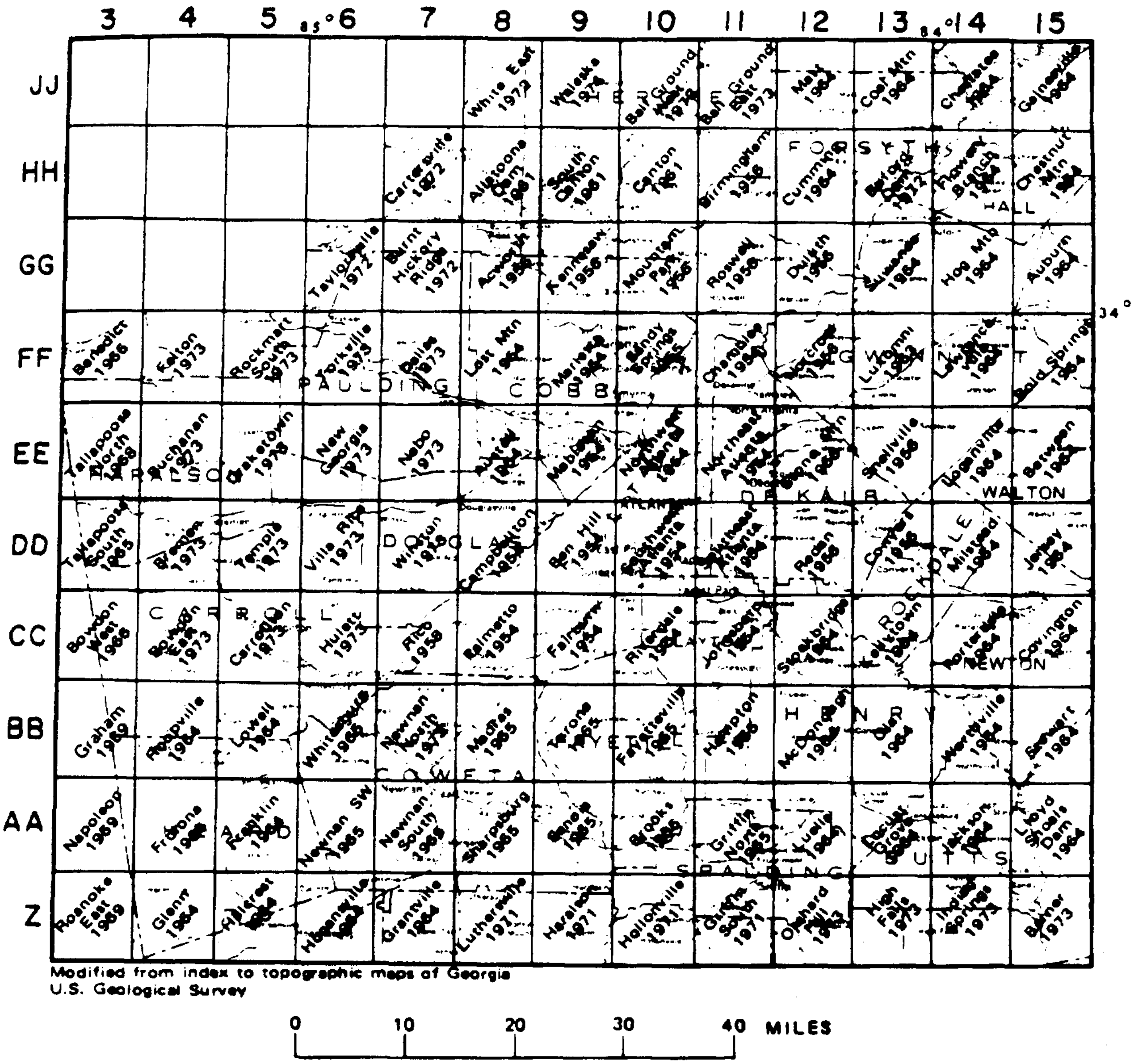


Figure 36. Water-level fluctuations in the U.S. Army, Fort McPherson observation well 10DD2 and in the O'Neil Brothers observation well 10DD1, Fulton County, and precipitation at Atlanta.



Modified from index to topographic maps of Georgia
U.S. Geological Survey

Figure 37. Number and letter designations for 7 1/2-minute quadrangles covering the Greater Atlanta Region.

influence of geologic control. The topography and drainage are closely related to bedrock permeability and therefore conventional methods for locating high-yielding well sites apply to most of the area. The south half of the area, on the other hand, has superimposed dendritic drainage style in which streams developed independently of the underlying bedrock. There, the topography and drainage are poorly related to bedrock permeability and high-yielding wells commonly occupy ridge crests, steep slopes, and bare-rock areas normally considered sites having low yield potential.

2. Geologic and topographic studies of 1,051 high-yielding well sites revealed that large well yields are available only where aquifers possess localized increases in permeability. This occurs mainly in association with specific structural and stratigraphic features: (1) contact zones between rock units of contrasting character and within multilayered rock units, (2) fault zones, (3) stress relief fractures, (4) zones of fracture concentration, (5) small-scale geologic structures that localize drainage development, (6) folds that produce concentrated jointing, and (7) shear zones. Methods were developed for selecting high-yielding well sites using these structural and stratigraph features.

3. Borehole sonic televiewer logs revealed that high-yielding water-bearing openings in granitic gneiss (Unit B), biotite gneiss (Unit D), gneiss interlayered with schist (Unit A), and quartz-mica schist (Unit C) consist mainly of horizontal or nearly horizontal fractures 1 to 8 inches in vertical dimension. The writers believe these are stress relief fractures formed by the upward expansion of the rock column in response to erosional unloading. Core drilling at two well sites confirmed the horizontal nature of the fractures and showed no indication of lateral movement that could be interpreted as faulting.

Wells that derive water from ho tal fractures characteristically essentially dry during drilling they penetrate the high-yielding ture. The high-yielding fractures or near the bottom of wells because the large yields were in excess c desired quantity and, therefore, dr ceased, or (2) in deep wells yieldi to 100 gal/min or more the large of water from the fracture(s) "dr out" the pneumatic hammers in the bits, effectively preventing deeper ling. Twenty-five wells in the area are known to derive water from tom-hole fractures, all of which ar lieved to be horizontal stress r fractures. The wells occupy a vari topographic settings, including valleys, ridge crests, steep slopes bare-rock areas, because horizontal tures are present beneath upland lowlands alike.

Wells deriving water from stres lief fractures have much greater av depth than wells reported from crystalline rock areas. Many o wells are 400 to 600 feet deep and water from a single fracture at the tom of the hole.

4. Contrary to popular belief, wells in the GAR are highly depen and have records of sustaining yields for many years. Sixty-six m industrial and municipal wells have pumped continuously for periods of more than 30 years without experie declining yields.

5. Large supplies of ground presently are available in the Most of the 1,165 high-yielding wel ventoried during the study supply f to more than 200 gal/min. The dist tion of these wells with respe topography and geology indicates most were located for the convenien the users and that the large yield sulted mainly from chance, rather from thoughtful site selection. B

ploying the site selection methods outlined in this report, it should be possible to develop large supplemental ground-water supplies in most of the area from comparatively few wells.

6. Well water in the area generally is of good chemical quality and is suitable for drinking and most other uses. Concentrations of dissolved constituents are fairly consistent throughout the area, and except for iron and manganese, rarely exceed drinking water standards. However, in some more densely populated areas, aquifer contamination from septic tank effluent is a significant problem.

SELECTED REFERENCES

Atkins, R. L., and Higgins, M. W., 1980, Superimposed folding and its bearing on geologic history of the Atlanta, Ga., area, in Excursions in Southeastern Geology, Geological Society of America, 1980 Annual Meeting Fieldtrip Guidebook, p. 19-40.

Back, William, and Barnes, Ivan, 1965, Relation of electrochemical potentials and iron content to ground-water flow patterns: U.S. Geological Survey Professional Paper 498-C, 16 p.

Barnes, Ivan, and Clarke, F. E., 1969, Chemical properties of ground water and their corrosion and encrustation effects on wells: U.S. Geological Survey Professional Paper 498-D, 58 p.

Billings, M. P., 1955, Structural geology: New York, Prentiss-Hall, 514 p.

Carter, R. W., and Herrick, S. M., 1951, Water resources of the Atlanta Metropolitan area: Georgia Geological Survey Circular 148, 19 p.

Carter, R. F., and Johnson, A. M. F., 1974, Use of water in Georgia, 1970, with projections to 1990: Georgia Geological Survey, Hydrologic Report 2, 74 p.

Clark, W. Z., and Zisa, A. C., 1976, Physiographic map of Georgia: Georgia Geological Survey, 1:200,000.

Crawford, T. J., 1969, Geologic map of Haralson-Paulding Counties, Georgia, in Hurst, V. J., and Crawford, T. J., Sulfide deposits in the Coosa Valley area, Georgia, 1970: Economic Development Administration Technical Assistance Project, U.S. Department of Commerce, 190 p., pls. 1, 2.

_____1970, Geologic map of Carroll-Heard Counties, Georgia, in Hurst, V. J., and Long, Sumner, Geochemical study of alluvium in the Chattahoochee-Flint area, Georgia, 1971: The University of Georgia Institute of Community and Area Development, 52 p.

_____1976, Geology of the Burnt Hickory Ridge quadrangle, Georgia: Georgia Geological Survey, open file.

_____1977, Geology of the Taylorsville quadrangle, Georgia: Georgia Geological Survey, open file.

_____1978, Geology of the Yorkville quadrangle, Georgia: Georgia Geologic Survey, open file.

_____1979, Geology of the Allatoona Dam quadrangle, Georgia: Georgia Geologic Survey, open file.

Crawford, T. J., and Medlin, J. H., 1974, The Brevard fault zone in western Georgia and eastern Alabama, in Geological Society of America Guidebook 12, Southeastern Section Annual Meeting: Atlanta, Georgia, Georgia Geological Survey, p. 1-67.

Cressler, C. W., 1970, Geology and ground-water resources of Floyd and Polk Counties, Georgia: Georgia Geological Survey Information Circular 39, 95 p.

Cressler, C. W., Blanchard, H. E., Jr., and Hester, W. G., 1979, Geohydrology of Bartow, Cherokee, and Forsyth Counties, Georgia: Georgia Geologic Survey Information Circular 50, 45 p.

Davis, Barry, 1969, Water-quality survey, Bartow County, Georgia: Economic Development Administration Publication 265, 33 p.

Fenneman, N. M., 1938, Physiography of Eastern United States: New York, McGraw-Hill, 714 p.

Georgia Department of Natural Resources, 1977: Rules for safe drinking water, Chapter 391-3-5, p. 601-657.

Georgia Geological Survey, 1976: Geologic Map of Georgia, 1:500,000.

Guyod, Hubert, and Shane, L. E., 1969, Geophysical well logging, Vol. I: Hubert Guyod, Houston, Texas, p. 232-235.

Hack, J. T., 1973, Stream-profile analysis and stream-gradient index: Journal of Research, U.S. Geological Survey, v. 1, no. 4, p. 421-429.

_____1978, Rock control and tectonism--their importance in shaping the Appalachian Highlands: U.S. Geological Survey Open-File Report 78-403, 38 p.

Hem, John D., 1970, Study and interpretation of the chemical characteristics of natural water, 2nd ed.: U.S. Geological Survey Water-Supply Paper 1473, 363 p.

Herrick, S. M., and LeGrand, H. E., 1949, Geology and ground-water resources of the Atlanta area, Georgia: Georgia Geological Survey Bulletin 55, 124 p.

Higgins, M. W., 1966, The geology of the Brevard lineament near Atlanta, Georgia: Georgia Geological Survey Bulletin 77, 49 p.

_____1968, Geologic map of the Brevard fault zone near Atlanta, Georgia: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-511.

Higgins, M. W., 1971, Cataclastic rocks: U.S. Geological Survey Professional Paper 687, 97 p.

Hollyday, E. F., and Goddard, P. L., 1979, Ground-water availability in carbonate rocks of the Dandridge area, Jefferson County, Tennessee: U.S. Geological Survey Open-File Report 79-1263, 50 p.

Hurst, V. J., and Long, Sumner, 1971, Geochemical study of alluvium in the Chattahoochee-Flint area, Georgia: University of Georgia Institute of Community and Area Development, 52 p.

Joiner, T. J., Warman, J. C., Scarbrough, W. L., and Moore, D. B., 1967, Geophysical prospecting for ground water in the Piedmont area, Alabama: Geological Survey of Alabama Circular 42, 48 p.

LaForge, Laurence, Cooke, Wythe, Keith, Arthur, and Campbell, M. R., 1925, Physical geography of Georgia: Georgia Geological Survey Bulletin 42, 189 p.

Leenheer, J. A., Malcolm, R. L., and White, W. R., 1975, Investigation of the reactivity and fate of certain organic components of an industrial waste after deep well injection: Environmental Science and Technology, v. 10, no. 5, May 1975, p. 445-451.

LeGrand, H. E., 1967, Ground water of the Piedmont and Blue Ridge Provinces in the Southeastern States: U.S. Geological Survey Circular 538, 11 p.

Lobeck, A. K., 1939, Geomorphology: New York, McGraw-Hill, 731 p.

Lohman, S. W., 1972, Ground-water hydraulics: U.S. Geological Survey Professional Paper 708, 70 p.

MacKenthum, K. M., and Ingram, W. M., 1967, Biological associated problems in freshwater environments: U.S. Department of the Interior, Federal Water Pollution Control Administration, 287 p.

McCallie, S. W., 1908, Underground waters of Georgia: Georgia Geological Survey Bulletin 15, 370 p.

McCollum, M. J., 1966, Ground-water resources and geology of Rockdale County, Georgia: Georgia Geological Survey Information Circular 33, 93 p.

Matthews, S. E., Hester, W. G., and O'Byrne, M. P., 1980, Ground-water data for Georgia, 1979: U.S. Geological Survey Open-File Report 80-50, 93 p.

Mayer, Larry, Prowell, D. C., and Reinhardt, Juergen, 1977, The subenvelope map as a tool for delineating linear features in the Georgia Piedmont and Coastal Plain: U.S. Geological Survey Open-File Report 77-695, 19 p.

Metropolitan Atlanta Water Resources Study, 1980: Drought management and water conservation: Atlanta Regional Commission, Staff Working Paper, 37 p.

Miller, L. M., 1961, Contamination by processed petroleum products, in Ground-water contamination: U.S. Department of Health, Education, and Welfare, Public Health Service, p. 117-119.

Parizek, R. R., 1971, Hydrogeologic framework of folded and faulted carbonates, in Geological Society of America Annual Fieldtrip Guidebook: Washington, D.C., November 1971, p. 9-75.

Pierce, Kenneth L., 1965, Geomorphic significance of a Cretaceous deposit in the Great Valley of southern Pennsylvania: U.S. Geological Survey Professional Paper 525-C, p. C152-C156.

Sever, C. W., 1964, Geology and ground-water resources of crystalline rocks, Dawson County, Georgia: Georgia Geological Survey Information Circular 30, 32 p.

Sonderegger, J. L., Pollard, L. D., and Cressler, C. W., 1978, Quality and availability of ground water in Georgia: Georgia Geologic Survey Information Circular 48, 25 p.

Staheli, A. C., 1976, Topographic expression of superimposed drainage on the Georgia Piedmont: Geological Society of America Bulletin, v. 87, p. 450-452.

Stewart, J. W., 1964, Infiltration and permeability of weathered crystalline rocks, Georgia Nuclear Laboratory, Dawson County, Georgia: U.S. Geological Survey Bulletin 1133-D, 59 p.

Stewart, J. W., and Herrick, S. M., 1963, Emergency water supplies for the Atlanta area in a National disaster: Georgia Geological Survey, Special Publication No. 1, 24 p.

Thomson, M. T., Herrick, S. M., Brown, Eugene, and others, 1956, The availability and use of water in Georgia: Georgia Geological Survey Bulletin 65, 329 p.

Trimble, S. W., 1970, The Alcovy River swamps--the result of culturally accelerated sedimentation: Georgia Academy of Science Bulletin 28, p. 131-141.

U.S. Army, Corps of Engineers, 1978, Water supply study of Coweta, Fayette, Henry, and Spalding Counties, Metropolitan Atlanta Area water resources management study: U.S. Army District Engineer, Savannah, Georgia, p. IV-9.

U.S. Bureau of the Census, 1971, Census of population, 1970, number of inhabitants, Georgia: U.S. Bureau of Census PC(1)-A12, Georgia, 41 p.

Table 9.—Record of wells in the Greater Atlanta Region—Continued

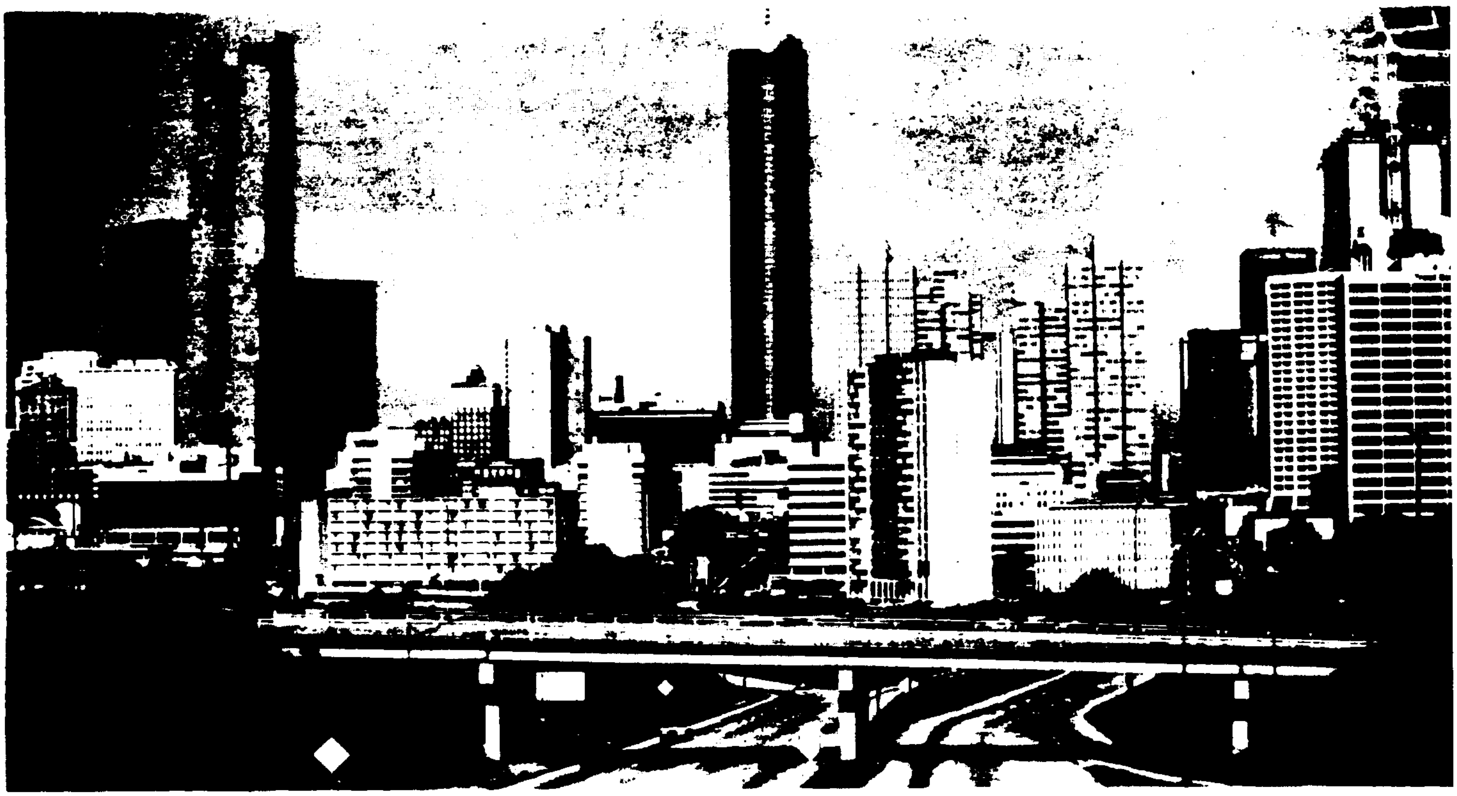
Well No.	Owner	Water-bearing unit	Latitude and longitude	Yield (gal/min)	Depth (ft)	Casing depth (ft)	Casing diam. (in.)	Date drilled	Driller	Elevation (ft)	Water level below land surface: Static head (ft)	Water level below land surface: Pumping head (ft)
Fulton County												
11EE10	[redacted] (b)(6) Personal 564 Wimbledon Rd. Atlanta	D	33°48'26" 84°22'07"	38	350	20	6	—	Virginia	900	40	200
11FF4	Landmark Apartments I-285 at 5775 Glenridge Rd. Atlanta	C	33°54'45" 84°21'35"	30	173	63	6	11/72	do.	950	10	173
11FF5	[redacted] (b)(6) Personal 24 Laurel Dr., NE Atlanta	M,C	33°55'46" 84°21'28"	25	318	79	6	7/60	do.	1,110	62	160
11FF6	Foxcroft Apartments 6851 Roswell Rd. Atlanta	A	33°56'31" 84°22'19"	60	106	45	6	1973	Ward	940	—	—
11FF7	Atlanta Assoc. of Baptist Churches 1900 Northridge Dunwoody	C	33°59'14" 84°19'32"	23	450	39	6	6/56	Virginia	920	60	180
11FF8	[redacted] (b)(6) Personal 1275 Riverside Rd. Roswell	C	33°59'25" 84°19'21"	50	201	19	6	5/66	do.	870	—	—
11FF9	Dr. Robert Smith, III 1750 Brandon Hall Dunwoody	A	33°59'04" 84°18'09"	40	205	70	6	12/76	do.	880	—	—
11FF10	[redacted] (b)(6) Personal 3450 Spalding Dr. Atlanta	M	33°57'57" 84°17'36"	30	185	—	6	8/67	do.	990	30	100
11FF11	[redacted] (b)(6) Personal 3400 Spalding Dr. Atlanta	C,M	33°57'55" 84°17'38"	75	—	—	—	1962	J.A. Wood	990	—	—
11FF12	[redacted] (b)(6) Personal 8099 Jett Ferry Dunwoody	A	33°58'13" 84°17'15"	30	150	27	6	5/55	Virginia	900	0	100
11FF14	[redacted] (b)(6) Personal 7700 Jett Ferry Dunwoody	M,A	33°57'53" 84°18'09"	100	153	51	6	8/79	—	1,100	—	—
11GG1	[redacted] (b)(6) Personal 400 Grimes Bridge Roswell	C,A	34°00'55" 84°20'15"	24	323	38	6	11/68	Virginia	1,080	—	—
11GG2	[redacted] (b)(6) Personal 350 Hollyberry Dr. Roswell	C	34°03'25" 84°21'00"	25	306	28	6	4/71	do.	1,100	—	—
11GG3	Jerry Bowden Tote Water Farms 12405 Etris Rd. Roswell	C	34°05'05" 84°22'06"	23	173	61	6	1/71	do.	1,060	—	173
11GG4	[redacted] (b)(6) Personal 335 Ranchette Rd. Alpharetta	C,A	34°06'04" 84°22'17"	50	126	46	6	9/71	Ward	1,080	—	--
11GG5	[redacted] (b)(6) Personal 185 Dorris Rd. Alpharetta	C	34°06'26" 84°21'24"	30	240	35	6	4/78	Virginia	1,020	—	--

Table 9.—Record of wells in the Greater Atlanta Region—Continued

Well No.	Owner	Water-bearing unit	Latitude and longitude	Yield (gal/min)	Depth (ft)	Casing depth (ft)	Casing diam. (in.)	Date drilled	Driller	Elevation (ft)	Water level below land surface: Static head (ft)	Water level below land surface: Pumping head (ft)
Fulton County												
11GG6	Fulton Co. Board of Education Northwestern School Crabapple	A	34°05'36 84°20'30"	60	200	22	6	1/55	Virginia	1,100	10	136
11GG7	[redacted] Haygood Rd. Alpharetta	A	34°07'11" 84°18'18"	24	234	26	6	12/65	do.	1,020	—	—
11GG8	City of Alpharetta Alpharetta	A	34°04'33" 84°17'38"	60	250	66	8	8/51	do.	1,130	—	120
11GG9	do.	E,A	34°04'12" 84°17'36"	75	300	—	10	—	—	1,090	—	—
11HH6	[redacted] Rte. 3, Red Rd. Alpharetta	E	34°07'46" 84°18'58"	30	—	—	—	—	Virginia	1,070	—	—
12FF1	Riverbend Gun Club Highway 141 Norcross	G	3°59'24" 84°10'12"	55	160	71	6	9/66	do.	880	—	—
12GG5	[redacted] 10505 Embry Farms Duluth	G	34°02'17" 84°07'35"	37	245	67	6	19/74	do.	930	20	245

GEOLOGY OF THE GREATER ATLANTA REGION

Keith I. McConnell and Charlotte E. Abrams



Department of Natural Resources
Environmental Protection Division
Georgia Geologic Survey

BULLETIN 96

iron ore deposits (Haseltine, 1924), and aluminosilicate deposits (Prindle, 1935; Furcron and Teague, 1945).

In the years between 1945 and 1966, only two reports on the northern Piedmont were published: Crickmay's (1952) *Geology of the crystalline rocks of Georgia* and Hurst's (1955) geologic map of the Kennesaw Mountain-Sweat Mountain area. In his report, Crickmay coined the belt terminology for Georgia and included what in this report is termed northern Piedmont in his Wedowee-Ashland and Tallulah belts.

Publications relating to the geology of the northern Piedmont picked up again in the late 1960's with Higgins' (1966) report and map (Higgins, 1968) on the Brevard zone. In these publications, Higgins outlined the general stratigraphy north of the Brevard fault zone near Atlanta and introduced the term Sandy Springs Sequence, which was subsequently revised to the Sandy Springs Group by Higgins and McConnell (1978a, 1978b). In the early 1970's Hurst published two regional studies (1970, 1973) on crystalline rocks in Georgia. In the latter of these, Hurst (1973) used the term "Blue Ridge" for what in this report is referred to as northern Piedmont. In addition, Hurst (1973), using terms originally introduced in Alabama by Adams (1926), defined the Ashland Group and Wedowee Formation in Georgia. These terms, derived from rock units described in Alabama, were used to define rocks in the southwestern part of the northern Piedmont. The use of these terms and their applicability are discussed in detail in a later section.

Hurst and Crawford (1970) published a report on the sulfide deposits of the Coosa Valley area which included geochemical maps as well as reconnaissance mapping in Paulding and Haralson Counties and descriptions of cores from various sources. Similar compilations were published by Long (1971) and Hurst and Long (1971) for the Chattahoochee-Flint area. Crawford and Medlin (1970, 1971, 1973, 1974) and Medlin and Crawford (1973) described the stratigraphy and structure of the northern Piedmont in west-central Georgia. These reports presented interpretations regarding the stratigraphy and structure of the area between the Cartersville and Brevard fault zones. Additional publications from the mid-to-early 1970's are: the petrology and geochemistry of some of the felsic gneisses in west Georgia (Coleman and others, 1973; Bearden, 1976; Sanders, 1977); origin and strontium isotope composition of amphibolites in the Cartersville to Villa Rica area (Hurst and Jones, 1973; Jones and others, 1973); a geologic map of Forsyth and parts of Fulton Counties (Murray, 1973); open-file maps of an area along the northwestern border of the northern Piedmont (Crawford, 1976, 1977a, 1977b); and K-Ar dates of rocks on either side of the Brevard zone (Stonebraker, 1973).

In the late 1970's there was a revival of interest in publications regarding economic minerals and their occurrences. Cook (1978b, 1978c) reported on soil geochemistry in the area of the Franklin-Creighton gold mine and on several other massive sulfide deposits in western Georgia. Somewhat later Abrams and others (1981), Abrams and McConnell (1981a, 1982a, 1982b, 1982c) and McConnell and Abrams (1982b, 1983) interpreted the massive sulfide and gold deposits in west Georgia to be volcanogenic in origin and showed the genetic and geographic relationship between banded iron formation and most of the major massive sulfide and gold deposits in west Georgia.

During the late 1970's and early 1980's the results of studies on stratigraphic and structural problems in the northern Piedmont on both local and regional scales were published. Higgins and McConnell (1978a; 1978b) revised and formalized the terminology of the Sandy Springs Group; Kline (1980, 1981) indicated that rocks of the Sandy Springs Group are present south of the Brevard fault zone; McConnell (1980a) described a metabasaltic unit with back-arc basin affinities (i.e., Pumpkinvine Creek Formation) on the northwestern border of the northern Piedmont; and Abrams and McConnell (1981a, 1981b) and McConnell and Abrams (1978) revised the stratigraphy and structural interpretations in [illegible] Villa Rica area emphasizing the influence [illegible] deformation in this area. Two regional studies were [illegible] in this period. McConnell and Costello (1980b) [illegible] across the northern Piedmont and southwestern [illegible] and defined the major rock units and structural [illegible] those two areas, and McConnell and Abrams (1982a) compiled the available data for the northern Piedmont onto one map.

SOUTHERN PIEDMONT AND BREVARD FAULT ZONE

The term southern Piedmont, as used in this report, consists of rocks southeast of the Brevard fault zone. This usage would include parts of King's (1955) Inner Piedmont belt and Crickmay's (1952) Dadeville belt.

As with all of the aforementioned geographic areas, some of the earliest work performed in the southern Piedmont was published in the form of bulletins describing economic mineral occurrences. Economic minerals and rocks that were discussed in this area include corundum (King, 1894); gold (Yeates and others, 1896; Jones, 1909); asbestos, soapstone and talc deposits (Hopkins, 1914); granites and gneisses (Watson, 1902); kyanite and vermiculite (Prindle, 1935), sillimanite and kyanite (Furcron and Teague, 1945); and pyrite deposits (Shearer and Hull, 1918).

The first significant study of the geology of the southern Piedmont outside of economic reports was that done by Crickmay (1952) in his study of the crystalline rocks in Georgia. Crickmay (1952) termed rocks of the Brevard fault zone the Brevard belt and rocks southeast of the Brevard the Dadeville belt. Two observations in Crickmay's report are interesting in light of the current ideas regarding the nature of the Brevard fault zone. Crickmay commented on the "button" schist, suggesting that it resulted from the formation of a second cleavage, and also noted that rocks of the Dadeville belt were "essentially a repetition of the rocks of the Tallulah belt . . ." (i.e., northern Piedmont) (Crickmay, 1952, p. 6).

Following the work of Crickmay, interest turned to the major post-metamorphic granite intrusives which are so prominent in the Piedmont southeast of the Brevard zone. Herrmann (1954) provided the first detailed mapping in the southern Piedmont in the Stone Mountain-Lithonia district. Herrmann (1954) described in detail the structure and petrography in this area as well as the aggregate industry that had developed. Beginning in 1957, a series of abstracts and articles was published regarding the age of some of the aforementioned granite intrusives. Pinson and others (1957) reported ages of approximately 280 m.y. for the Stone Mountain Granite, 290 m.y. for the Lithonia Gneiss, and 340 m.y. for the Ben Hill Granite. Subsequent publications by Pinson and others (1957a, 1958) and Grunenfelder and Silver

(1958) redefined the ages for the previously mentioned rock units and gave an age of approximately 295 m.y. for the Panola Granite. Interest in the age of these post-metamorphic intrusive rocks continued into the 1960's, 1970's and 1980's as the methodology of isotopic dating improved and the precision of the age determinations was refined. Although the exact ages for these intrusive bodies varied, the succeeding reports (i.e., Long and others, 1959; Whitney and others, 1976; Dallmeyer, 1978; Atkins and Higgins, 1980; Higgins and Atkins, 1981) essentially confirmed late Paleozoic ages for the post-metamorphic intrusive rocks. The results of investigations into the timing of metamorphism were being reported at the same time as ages for post-metamorphic intrusives. Initial K-Ar work on schists and gneisses in the southern Piedmont by Pinson and others (1957), Kulp and Eckelmann (1961) and Long and others (1959) indicated ages from approximately 350 m.y. to 250 m.y. with a distinct "younging" trend to the southeast from Atlanta. Kulp and Eckelmann (1961) suggested that these ages indicated two periods of regional metamorphism; one at approximately 350 m.y. and the second near 250 m.y. ago. Using the above ages, Hurst (1970) coined the term "hot belt" for the area containing the younger ages. Stonebraker (1973) provided additional K-Ar analyses on samples from traverses across the Brevard zone near Atlanta. Finally, Dallmeyer (1975) indicated that $^{40}Ar/^{39}Ar$ ages suggested that the younger age-dates obtained by K-Ar methods are the result of differences in cooling and uplift rates. He suggested an age of 365 m.y. for peak metamorphism of the region described here as southern Piedmont (Dallmeyer, 1975).

Outside of isotopic dating efforts, geologic interest in the southern Piedmont during the late 1950's and 1960's was concentrated around the Stone Mountain Granite. Reports regarding mineralogical variation (Wright, 1966), weathering (Grant, 1963), and intrusion mechanics (Grant, 1969) of the Stone Mountain Granite were published during this time period. Grant (1962) also led a field trip into the Stone Mountain-Lithonia district. The 1970's and early 1980's saw a continuation of geologic interest in the Stone Mountain Granite. Reports on the origin (Whitney and others, 1976) and geochemistry (Atkins and others, 1980b) of the Stone Mountain Granite as well as another field trip guidebook for the area (Grant and others, 1980) were published.

After a gap of over a decade, publication on the stratigraphy and structure of the southern Piedmont resumed in the mid-1960's with the publications on the Brevard zone by Higgins (1966, 1968). In the recent past, reports regarding the various aspects of stratigraphy and structure were published (i.e., Atkins and Higgins, 1978, 1980; Atkins and others, 1980a; Higgins and others, 1980a, 1980b; Higgins and Atkins, 1981; Kline, 1980, 1981).

Much of the preceding geologic information from all of the aforementioned geographic areas was included in the compilation of the 1976 State Geologic Map of Georgia. This map also included unpublished reconnaissance mapping by various geologists (Georgia Geologic Survey, 1976).

STRATIGRAPHY

Introduction

Detailed and reconnaissance geologic mapping has formed the basis on which stratigraphic successions for the Blue Ridge, northern Piedmont and southern Piedmont were developed. Much of this mapping expanded upon earlier reconnaissance mapping by many authors.

In the Blue Ridge, the proposed stratigraphic terminology and correlations are, to some degree, a return to those of C.W. Hayes (1895) in his unpublished report on the Cartersville 30-minute sheet. Although written nearly 100 years ago, Hayes' report on the Cartersville area, particularly the stratigraphic correlations and his interpretation of the relationship between the Corbin Gneiss Complex and its cover rocks, is consistent with our interpretations.

South of the Allatoona fault and north of the Brevard zone, imprecise and over-extended terms such as Ashland and Wedowee are abandoned in favor of two major groups (i.e., New Georgia and Sandy Springs Groups) that are distinguished on the basis of lithology, protolith, and depositional environment. Resolution of a recognizable stratigraphy in the northern Piedmont also has led to the recognition of stratigraphic indicators for massive sulfide and gold deposits (Abrams and McConnell, 1982a).

Southeast of the Brevard fault zone, Higgins and Atkins (1981) defined the Atlanta Group. In this report, we use units defined by Higgins and Atkins, but reinterpret the structural setting, redefining the major structural feature, the Newnan-Tucker synform, as a synformal anticline rather than a synformal syncline as originally proposed (Higgins and Atkins, 1981). The stratigraphic succession used in the Valley and Ridge is after Cressler (1970) and Cressler and others (1979), which were modified from Hayes (1902) and Butts and Gildersleeve (1948).

The following discussion describes in detail only those rock units that are in areas which have undergone substantial revision during this investigation. In this report capitalization of previously defined stratigraphic units follows the original author's usage unless otherwise defined in this text. For a description of all stratigraphic units within the Greater Atlanta Regional area see Appendix A of this report.

Stratigraphy of the Valley and Ridge

Rocks ranging in age from Lower Cambrian(?) to Pennsylvanian are present in the Valley and Ridge portion of the Greater Atlanta Regional Map. Our work in the Valley and Ridge portion of the Greater Atlanta Region was directed at an area in the immediate vicinity of Cartersville (Fig. 2). For this reason we have limited our discussion of Valley and Ridge stratigraphy to rocks in that area. This means that only Lower Cambrian rocks (Chilhowee through Rome Formations) are discussed. The reader is referred to Appendix A for detailed descriptions of the Middle Cambrian through Pennsylvanian section in this area.

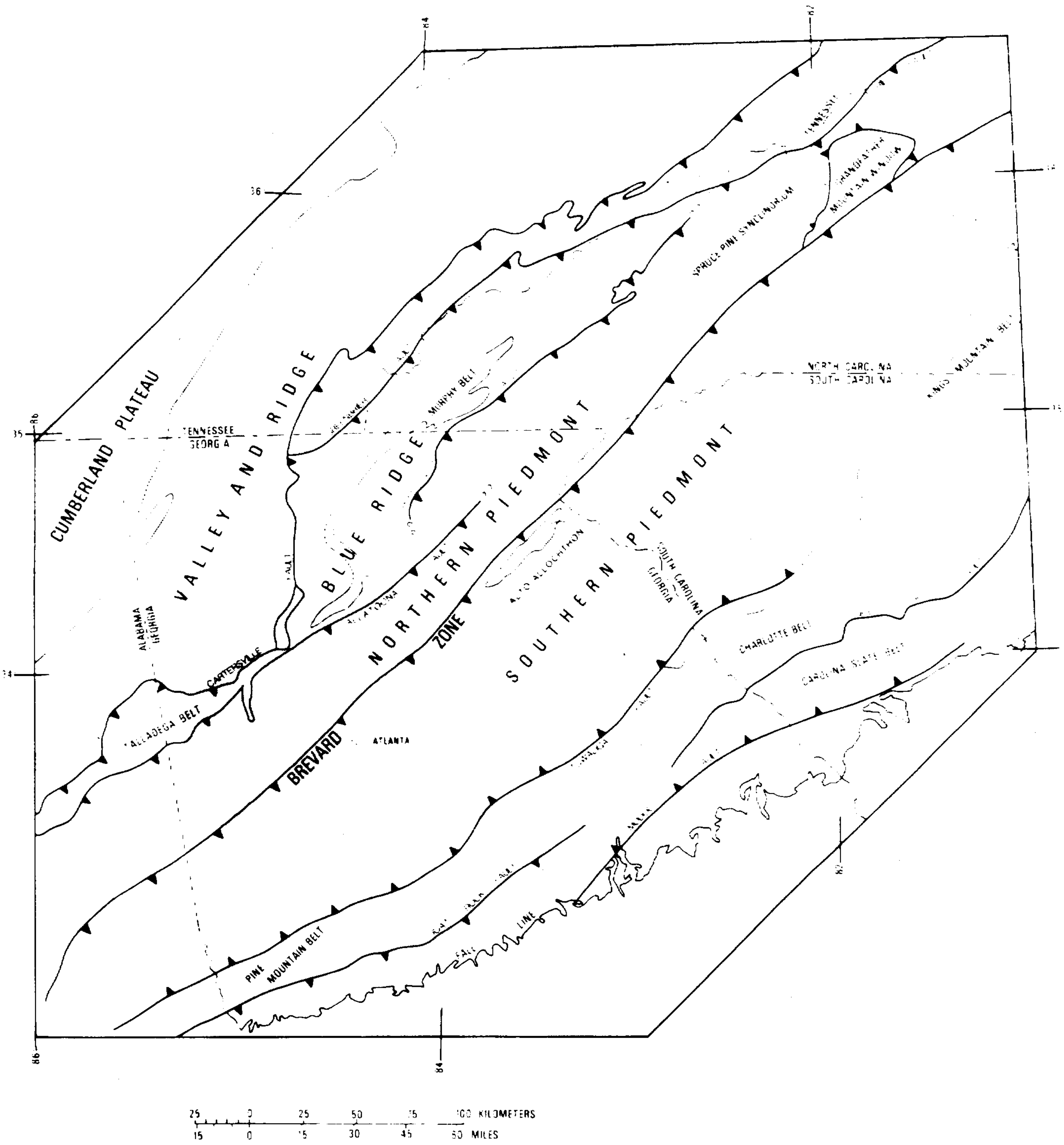


Figure 2. Regional location map showing boundaries of the Greater Atlanta Regional Map and regional setting of map area (modified after McConnell and Costello, 1982).

Stratigraphic control is another aspect to the Brevard fault zone. Hatcher (1975, 1978a) indicated that the Brevard fault zone was stratigraphically controlled for at least part of its length and is bordered by several equivalent rock units (i.e., Heard group, Sandy Springs Group, Tallulah Falls Formation, Ashe Formation) for most of its length. In the Greater Atlanta Regional Map area, the stratigraphic distinction is not as clear as it is to the northeast. Although the Sandy Springs Group is present along the northwestern boundary of the Brevard zone in the Greater Atlanta Region, the absence of units defined as Chauga River Formation (Hatcher, 1969) south of Flowery Branch complicates the issue of stratigraphic control of the Brevard zone. In this area, rocks of the Sandy Springs Group occur on both sides of the Brevard fault zone (Kline, 1980, 1981). However, the Wolf Creek Formation (Higgins and Atkins, 1981), a unit composed of thinly laminated amphibolite interlayered with "button" schist, is lithologically and texturally similar to and in the same relative tectonic position as the Poor Mountain Formation in northeastern Georgia where the Poor Mountain Formation borders on the Alto Allochthon (Hatcher, 1978b). The Wolf Creek Formation may represent the lithostratigraphic equivalent of a portion of the Poor Mountain Formation and the stratigraphic association of the Brevard fault zone readily apparent to the northeast would be present at least as far southwest as Atlanta. A speculative extension of this correlation would be that the rocks exposed in the Newnan-Tucker synform may represent another allochthon resting on Poor Mountain Formation equivalents.

SOUTHERN PIEDMONT

In the recent past, the so-called "belt" terminology or geographic separation of rocks (i.e., northern and southern) was criticized for its ambiguity and in some cases its inapplicability (Crawford and Medlin, 1970; Medlin and Crawford, 1973; McConnell, 1980b). However, no suitable replacement was proposed to enable geographic placement of various rock sequences within the regional geologic framework. In the Atlanta area, rock sequences north of the Brevard fault zone were redefined by one set of workers (McConnell and Costello, 1980b; Abrams and McConnell, 1981a; McConnell and Abrams, 1982a, 1982b; this report), while south of the Brevard, another set of workers has redefined stratigraphic relationships (Atkins and Higgins, 1980; Higgins and Atkins, 1981). Although similar rocks and stratigraphic sequences exist on both sides of the Brevard zone, little effort has gone into relating the two areas. Thus, the geologic distinction between rocks on either side of the Brevard zone is more apparent than real.

Atlanta Group

Studies of stratigraphic relationships within that portion of the Greater Atlanta Regional Map southeast of the Brevard zone generally are limited to two reports (Atkins and Higgins, 1980; Higgins and Atkins, 1981). These reports define a stratigraphic succession of rocks (Atlanta Group, Fig. 11) that occurs in either a synformal anticline or a synformal syncline (Higgins and Atkins, 1981). Higgins and Atkins (1981) interpret this structure as a syncline, but indicate that the stratigraphic sequence they propose is inverted if the alternative hypothesis is correct. Many rock units defined by Higgins and Atkins (1981) are lithologically similar to units defined northwest of the Brevard fault zone (Appendix A gives a brief description of all rock units in the Greater Atlanta Regional Map south of the Brevard fault zone). In the Atlanta area, Kline (1980, 1981) and McConnell (1980b) indicated that rocks of the Sandy Springs Group are present on both sides of the Brevard fault zone. This is consistent with observations farther northeast (Hatcher, 1978b), as well as those related to this report (Plate Ia). The recognition that similar rock sequences exist on both sides of the Brevard zone opens the way for a reinterpretation of stratigraphic relationships within Higgins and Atkins' (1981) Atlanta Group using age and structural relationships established north of the Brevard zone. Rocks northwest of the Brevard zone can serve as a guide for stratigraphic interpretation because of the nonconformable relationship between Grenville basement and Sandy Springs Group equivalent Tallulah Falls Formation in northeastern Georgia (Hatcher, 1974, 1977). Therefore, some indication of stratigraphic "up" is available northwest of the Brevard zone. Comparing mineralogical characteristics of some units in the Atlanta Group with those defined in the northern Piedmont also allows for the reinterpretation of the origin of several rock units defined by Higgins and Atkins (1981), in particular, the Intrenchment Creek Quartzite. The Intrenchment Creek Quartzite is defined as a spessartine-bearing quartzite (coticule rock) and mica schist unit that is composed locally of 15 to 30 percent spessartine garnet and 70 to 85 percent quartz (Higgins and Atkins, 1981). The chemical composition of this rock is attributed to be the result of "halmyrolytic alteration" of oceanic sediments associated with mafic volcanic rocks by Higgins and Atkins (1981, pg. 20). However, spessartine-bearing quartzites are common in the predominantly volcanogenic New Georgia Group northwest of the Brevard zone and in volcanogenic sequences elsewhere (John Slack, personal commun., 1982). In the New Georgia Group spessartine quartzites are associated with banded iron formation. In addition, manganiferous quartzites are a facies of banded iron formation in the Draketown area and contain up to 53 percent manganese (Abrams and McConnell, unpublished data). We suggest that a more likely origin for the Intrenchment Creek Quartzite is derivation from exhalative processes and deposition as a siliceous chemical sediment within a volcanic terrain. The aluminous nature of the quartzite may suggest inclusion of a clay fraction (Abrams and McConnell, 1982b). The presence of garnet facies iron formation in association with mafic and felsic volcanics (i.e., Camp Creek and Big Cotton Indian Creek Formations; Higgins and Atkins, 1981) southeast of the Brevard fault zone is similar to relationships observed in the New Georgia Group northwest of the Brevard zone. The fact that similar stratigraphic sequences are present on both sides of the Brevard zone (Hatcher, 1972, 1978b; Crawford and Medlin, 1973; Kline, 1980, 1981; McConnell, 1980b) and that lithologic similarities exist between the New Georgia Group and the Intrenchment Creek Quartzite, Camp Creek Formation, Big Cotton Indian Creek sequence suggest that they formed in similar environments, possibly contemporaneously. If the above-mentioned stratigraphic sequences are coeval, a basis for reinterpreting the character of the Newnan-Tucker synform (Higgins and Atkins, 1981) exists. In this report, the Camp Creek Formation, Big Cotton Indian Creek Formation and Intrenchment Creek Quartzite are interpreted as the oldest units in the Atlanta Group (analogous to the New Georgia Group northwest of the Brevard fault zone) and the Newnan-Tucker synform, therefore, is a synformal anticline with stratigraphically younger units occurring on limbs of the structure (Plate I). Sandy Springs Group rocks and their probable equivalents[1] in the Atlanta Group (Table 11, Plate Ib) are present on the limbs of the synform and stratigraphically overlie New Georgia Group equivalents (Plate I).

We also suggest that the relationship of Snellville Formation rocks to the Lithonia Gneiss is more likely a fault than an unconformity as previously suggested by Atkins and Higgins (1980). Atkins and Higgins (1980) interpreted this contact as an unconformity, but also gave evidence for characterizing this contact as a fault. This bulletin favors the latter interpretation of this contact primarily because of evidence cited by Atkins and Higgins (1980). Also, the "unconformity" interpretation requires a second Paleozoic metamorphic event for which, in the Greater Atlanta Region, there is a lack of strong evidence. However, due to a lack of detailed mapping in the area by the authors of this bulletin, the contact is expressed as a stratigraphic contact on Plate I.

Outside of the area mapped by Higgins and Atkins (1981) little to no data are available for compilation. Information that does exist is in the form of open-file maps. Other areas (i.e., the easternmost part of the Greater Atlanta Regional Map) where no detailed data are available for compilation are left blank (Plate I). Open-file mapping of Crawford and Medlin (Georgia Geologic Survey, 1976) was used in the southwesternmost portion of the Greater Atlanta Regional Map.

[1] Lithologic descriptions of rocks in the Wolf Creek Formation, Norcross Gneiss and, in part, the Promised Land Formation (Atkins and Higgins, 1980) resemble lithologies in the New Georgia Group and may represent New Georgia equivalents. This correlation would require that other members of the Atlanta Group be part of an allochthonous sheet resting on the Wolf Creek Formation, etc. as was previously proposed in the Brevard Fault Zone section.

Regional Correlations

The similarity between rock units and stratigraphic sequences across the Brevard fault zone was previously discussed in this and previous reports (Crawford and Medlin, 1973; Hatcher, 1972, 1978b). In general, correlatives of the Sandy Springs and New Georgia Groups are believed to occur southeast of the Brevard fault zone in rocks defined as Atlanta Group. We speculate that, although complicated by intrusion of late Paleozoic plutons and the presence of large migmatitic terranes such as the Lithonia Gneiss, rocks defined as Atlanta Group by Higgins and Atkins (1981) probably were deposited in similar environments and had similar provenance to the New Georgia and Sandy Springs Group rocks. Therefore, correlations made in a previous section for rocks of the New Georgia and Sandy Springs Groups (i.e., equivalent to Ashe Formation) may be applicable for rocks of the Atlanta Group.

PLUTONIC ROCKS

Post Grenville-age intrusive rocks generally are limited to the Piedmont portion of the Greater Atlanta Region, although numerous pegmatites occur in the Blue Ridge (Galpin, 1915). In the Greater Atlanta Regional Map area, plutons of known Grenville and possibly older age are restricted to the Corbin Gneiss Complex east of a Cartersville in the Blue Ridge province (Fig. 4) where a 1,000-m.y.-old, coarse, megacrystic facies crosscuts a metasedimentary precursor (Costello, 1978; McConnell and Costello, 1984).

Table 11. Proposed correlation chart of northern and southern Piedmont lithologic units.

<table>
<tr><th colspan="2">Atlanta Group
modified after Higgins and Atkins, 1981</th><th>Sandy Springs and New Georgia Groups
this paper</th></tr>
<tr><td rowspan="2">Snellville Formation</td><td>Norris Lake Schist</td><td>Factory Shoals Formation</td></tr>
<tr><td>Lanier Mountain Quartzite Member</td><td>Chattahoochee Palisades Quartzite</td></tr>
<tr><td>Inman Yard Formation</td><td>Promised Land Formation</td><td rowspan="7">Powers Ferry Formation Undifferentiated</td></tr>
<tr><td>Norcross Gneiss</td><td>Wolf Creek Formation</td></tr>
<tr><td>Clairmont Formation</td><td>Senoia Formation</td></tr>
<tr><td colspan="2">Wahoo Creek Formation</td></tr>
<tr><td colspan="2">Stonewall Formation</td></tr>
<tr><td rowspan="2">Clarkston Formation</td><td>Fairburn Member</td></tr>
<tr><td>Tar Creek Member</td></tr>
<tr><td>Big Cotton Indian Formation</td><td>Intrenchment Creek Quartzite</td><td rowspan="2">New Georgia Group</td></tr>
<tr><td colspan="2">Camp Creek Formation</td></tr>
</table>

ag	**Austell Gneiss** (Abrams and McConnell, 1981a; Abrams, 1983): fine- to coarse-grained blastoporphyritic to nonporphyritic orthogneiss composed of muscovite, biotite, oligoclase, quartz and microcline.
shg	**Sand Hill Gneiss** (this report): fine- to coarse-grained blastoporphyritic to nonporphyritic orthogneiss composed of muscovite, biotite, oligoclase, quartz and microcline. Generally contains more muscovite, quartz and plagioclase and less microcline than Austell Gneiss.
mrg	**Mulberry Rock Gneiss** (this report): medium-grained, equigranular muscovite-quartz-microcline-plagioclase orthogneiss.
d	**Diabase dikes**

SOUTHERN PIEDMONT PROVINCE AND BREVARD FAULT ZONE

Atlanta Group (late Precambrian to early Paleozoic)
(stratigraphic order revised after Higgins and Atkins, 1981):

cc	**Camp Creek Formation** (Higgins and Atkins, 1981): massive granite gneiss interlayered with thin, fine-grained, dark-green hornblende-plagioclase amphibolite.
icq	**Intrenchment Creek Quartzite** (Higgins and Atkins, 1981): spessartine quartzite and spessartine-mica schist interpreted in this report to be banded iron formation.
bci	**Big Cotton Indian Formation** (Higgins and Atkins, 1981): intercalated biotite-plagioclase gneiss (locally porphyritic), hornblende-plagioclase amphibolite, and biotite-muscovite schist.
ca tc f	**Clarkston Formation** (Higgins and Atkins, 1981): sillimanite-garnet-quartz-plagioclase-biotite-muscovite schist interlayered with hornblende-plagioclase amphibolite (ca). Includes a unit composed only of schist termed the Fairburn Member (f); and a unit similar to Clarkston undifferentiated termed the Tar Creek Member (tc).
st	**Stonewall Formation** (Higgins and Atkins, 1981): intercalated fine-grained biotite gneiss, hornblende-plagioclase amphibolite and sillimanite-biotite schist.
wac	**Wahoo Creek Formation** (Higgins and Atkins, 1981): includes slabby, medium-grained muscovite-plagioclase-quartz gneiss, amphibolite, mica schist and epidote-calcite-diopside gneiss (calc-silicate).
se	**Senoia Formation** (Atkins and Higgins, 1981): garnet-biotite-muscovite schist interlayered with fine-grained amphibolite, local thin layers of spessartine quartzite (iron formation?), sillimanite schist and biotite gneiss.
cl	**Clairmont Formation** (Higgins and Atkins, 1981): interlayered medium-grained biotite-plagioclase gneiss and fine- to medium-grained hornblende-plagioclase amphibolite.
pl h	**Promised Land Formation** (Higgins and Atkins, 1981): includes massive to thinly layered, medium-grained, gray, banded biotite granite gneiss interlayered with fine-grained, dark-green to greenish black, blocky amphibolite. A thin quartzite and muscovite quartz schist unit near top of the Promised Land Formation is termed the Hannah Member (h).
wc	**Wolf Creek Formation** (Higgins and Atkins, 1981): thinly laminated, fine-grained amphibolite interlayered with lustrous, silvery, gray, biotite-muscovite schist.

National Water Summary 1984

Hydrologic Events
Selected Water-Quality Trends and Ground-Water Resources

United States Geological Survey
Water-Supply Paper 2275

National
Water Summary 1984

Hydrologic Events, Selected Water-Quality Trends, and Ground-Water Resources

By United States Geological Survey

United States Geological Survey
Water-Supply Paper 2275

DEPARTMENT OF THE INTERIOR
DONALD PAUL HODEL, Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

UNITED STATES GOVERNMENT PRINTING OFFICE: 1985

For sale by the Superintendent of Documents,
U.S. Government Printing Office,
Washington, DC 20402

GEORGIA
Ground-Water Resources

Ground water is an abundant natural resource in Georgia and comprises 18 percent of the total freshwater used (including thermoelectric) in the State. Georgia's aquifers provide water for more than 2.6 million people, or almost one-half of the total population of the State. Of this number, about one-half are served by public water-supply systems and one-half by rural water-supply systems. Most ground-water withdrawals are in the southern one-half of the State where the aquifers are very productive. Ground-water withdrawals in 1980 for various uses, and related statistics, are given in table 1.

GENERAL SETTING

Differing geologic features and landforms of the several physiographic provinces of Georgia cause significant differences in ground-water conditions from one part of the State to another (fig. 1). The most productive aquifers in the State are located in the Coastal Plain province in the southern one-half of Georgia; the province is underlain by alternating layers of sand, clay, and limestone that dip and thicken to the southeast. Aquifers generally are confined in the Coastal Plain, except near their northern limit where the formations are exposed or are near land surface. Principal aquifers of the Coastal Plain include the Floridan aquifer system, the Claiborne aquifer, the Clayton aquifer, and the Cretaceous aquifer system (table 2). The Piedmont and Blue Ridge provinces, which include most of the northern one-half of Georgia, are underlain by massive igneous and metamorphic rocks that form aquifers of very low permeability. The Valley and Ridge and Appalachian Plateaus provinces, which are in the northwestern corner of Georgia, are underlain by layers of sandstone, limestone, dolostone, and shale of Paleozoic age.

Recharge to the ground-water system in Georgia is derived almost entirely from precipitation. Average annual precipitation based on the 30-year period of record (1941-70) is about 50 inches (in.) statewide and ranges from about 44 in. in the east-central part of the State to about 76 in. in the northeastern corner of the State. Of this amount, about 88 percent is discharged to streams or is lost to evapotranspiration, and about 12 percent enters the ground-water system as recharge (Carter and Stiles, 1983).

Table 1. Ground-water facts for Georgia

[Withdrawal data rounded to two significant figures and may not add to totals because of independent rounding. Mgal/d = million gallons per day; gal/d = gallons per day. Source: Solley, Chase, and Mann, 1983]

Population served by ground water, 1980	
Number (thousands)	2,604
Percentage of total population	48
From public water-supply systems:	
Number (thousands)	1,320
Percentage of total population	24
From rural self-supplied systems:	
Number (thousands)	1,284
Percentage of total population	23
Freshwater withdrawals, 1980	
Surface water and ground water, total (Mgal/d)	6,700
Ground water only (Mgal/d)	1,200
Percentage of total	8
Percentage of total excluding withdrawals for thermoelectric power	52
Category of use	
Public-supply withdrawals:	
Ground water (Mgal/d)	230
Percentage of total ground water	19
Percentage of total public supply	29
Per capita (gal/d)	174
Rural-supply withdrawals:	
Domestic:	
Ground water (Mgal/d)	0
Percentage of total ground water	2
Percentage of total rural domestic	100
Per capita (gal/d)	109
Livestock:	
Ground water (Mgal/d)	17
Percentage of total ground water	1
Percentage of total livestock	61
Industrial self-supplied withdrawals:	
Ground water (Mgal/d)	400
Percentage of total ground water	34
Percentage of total industrial self-supplied:	
Including withdrawals for thermoelectric power	8
Excluding withdrawals for thermoelectric power	57
Irrigation withdrawals:	
Ground water (Mgal/d)	380
Percentage of total ground water	32
Percentage of total irrigation	56

PRINCIPAL AQUIFERS

FLORIDAN AQUIFER SYSTEM

The Floridan aquifer system is one of the most productive ground-water reservoirs in the United States. More than 600 million gallons per day (Mgal/d) is withdrawn from the aquifer system in Georgia (1980), making it the principal source of ground water in the State. The aquifer system generally is confined but is semiconfined to unconfined near its northern limit and near areas of karst topography in the Dougherty Plain and near Valdosta. In parts of the area where the Floridan aquifer system is exposed or is near land surface, intensive pumping can contribute to the formation of sinkholes. Although water suitable for most uses can be obtained from the aquifer system throughout most of the Coastal Plain, water-quality problems have occurred in some areas. The following examples serve to illustrate the problem: (1) at Brunswick, the intrusion of brackish water into the aquifer system resulted in chloride concentrations of as much as 1,000 milligrams per liter (mg/L) in some wells (Wait and Gregg, 1973), (2) in the area of Wheeler and Montgomery Counties in central-south Georgia, naturally occurring radioactivity exceeds 25 picocuries per liter (S. S. McFadden, Georgia Geologic Survey, oral commun., September 1984), (3) in nearby Ben Hill County, barium concentrations of as much as 2.1 mg/L are present in some wells (S. S. McFadden, Georgia Geologic Survey, oral commun., September 1984), (4) at Valdosta, naturally occurring organic substances, color, and hydrogen sulfide gas have been a cause of concern (Krause, 1979), and (5) in the Dougherty Plain area, small concentrations of commonly used pesticides have been [illegible]ed in some farm wells (Hayes and others, 1983).

Claiborne Aquifer

The Claiborne aquifer is an important source of water in part of southwestern Georgia (fig. 1) and supplied an estimated 36 Mgal/d in 1980, primarily for irrigation (McFadden and Perriello, 1983). Although the Claiborne aquifer yields water suitable for most uses over most of its extent, naturally occurring concentrations of dissolved solids and chloride in the south-central part of the State have been reported as 22,200 and 11,900 mg/L, respectively (Wait, 1960).

Clayton Aquifer

The Clayton aquifer is an important source of water in southwestern Georgia (fig. 1), where it supplied an estimated 20 Mgal/d in 1980. Most of the withdrawals were for public supply (58 percent) and irrigation (35 percent). With the exception of large concentrations of iron (greater than 0.3 mg/L) in Randolph County, water from the aquifer is suitable for most uses (Clarke and others, 1984).

Cretaceous Aquifer System

The Cretaceous aquifer system is a major source of water in the northern one-third of the Coastal Plain (fig. 1). During 1980, the aquifer system yielded an estimated 128 Mgal/d, primarily for industrial and public-supply use. The aquifer system consists of sand and gravel that locally contain layers of clay and silt which function as confining beds. These confining beds locally separate the aquifer system into two or more aquifers. In southwestern Georgia, the Providence aquifer is part of the Cretaceous aquifer system. Water from the aquifer system is soft (less than 60 mg/L as calcium carbonate), has little dissolved solids (generally less than 100 mg/L), and is of a sodium bicarbonate type that is suitable for most uses. In the center of the area of usage (fig. 1), the iron concentration may be as much as 6.7 mg/L.

Paleozoic Aquifers

Water in the Paleozoic aquifers generally is unconfined, and storage is limited mainly to joints, fractures, and solution openings in the bedrock. During 1980, an estimated 33 Mgal/d was withdrawn from the Paleozoic aquifers, primarily for industrial supply. Wells that tap the Paleozoic aquifers yield differing amounts of water, depending on the aquifer used. Dolostone aquifers typically yield 5 to 50 gallons per minute (gal/min), whereas limestone and sandstone aquifers typically yield 1 to 20 gal/min; maximum reported yields from these aquifers are 3,500 and 300 gal/min, respectively. Springs discharge from the limestone and dolostone aquifers at rates of as much as 5,000 gal/min. Where the limestone and dolostone aquifers are near land surface, pumping can contribute to the formation of sinkholes. Water from wells and springs in the Paleozoic aquifers generally is suitable for most uses, although contamination from septic tanks and farm waste has been reported (Cressler and others, 1976).

Crystalline Rock Aquifers

Although individual crystalline rock aquifers are not laterally extensive, collectively they yielded an estimated 99 Mgal/d in 1980, primarily for rural supply. Ground-water storage occurs in the regolith and where the rocks have joints, fractures, and other types of secondary openings (Cressler and others, 1983). Crystalline rock aquifers in these areas generally are unconfined and show a pronounced response to rainfall, although deep fracture systems commonly are confined. Water from the aquifers generally is suitable for most uses, and, with the exception of iron (as much as 14 mg/L) and manganese (as much as 1.5 mg/L), constituent concentrations rarely exceed national drinking-water regulations (U.S. Environmental Protection Agency, 1982a,b). In some densely populated areas, septic-tank effluent has contaminated the aquifers (Cressler and others, 1983).

GROUND-WATER WITHDRAWALS AND WATER-LEVEL TRENDS

Major areas of ground-water withdrawals and trends in ground-water levels near selected pumping centers are shown in figure 2. With the exception of one center in the Valley and Ridge province (location 1, fig. 2), all major pumping centers are in the Coastal Plain, where aquifers are very productive. The largest pumping center is the Dougherty Plain area where ground-water withdrawal for irrigation exceeds 200 Mgal/d.

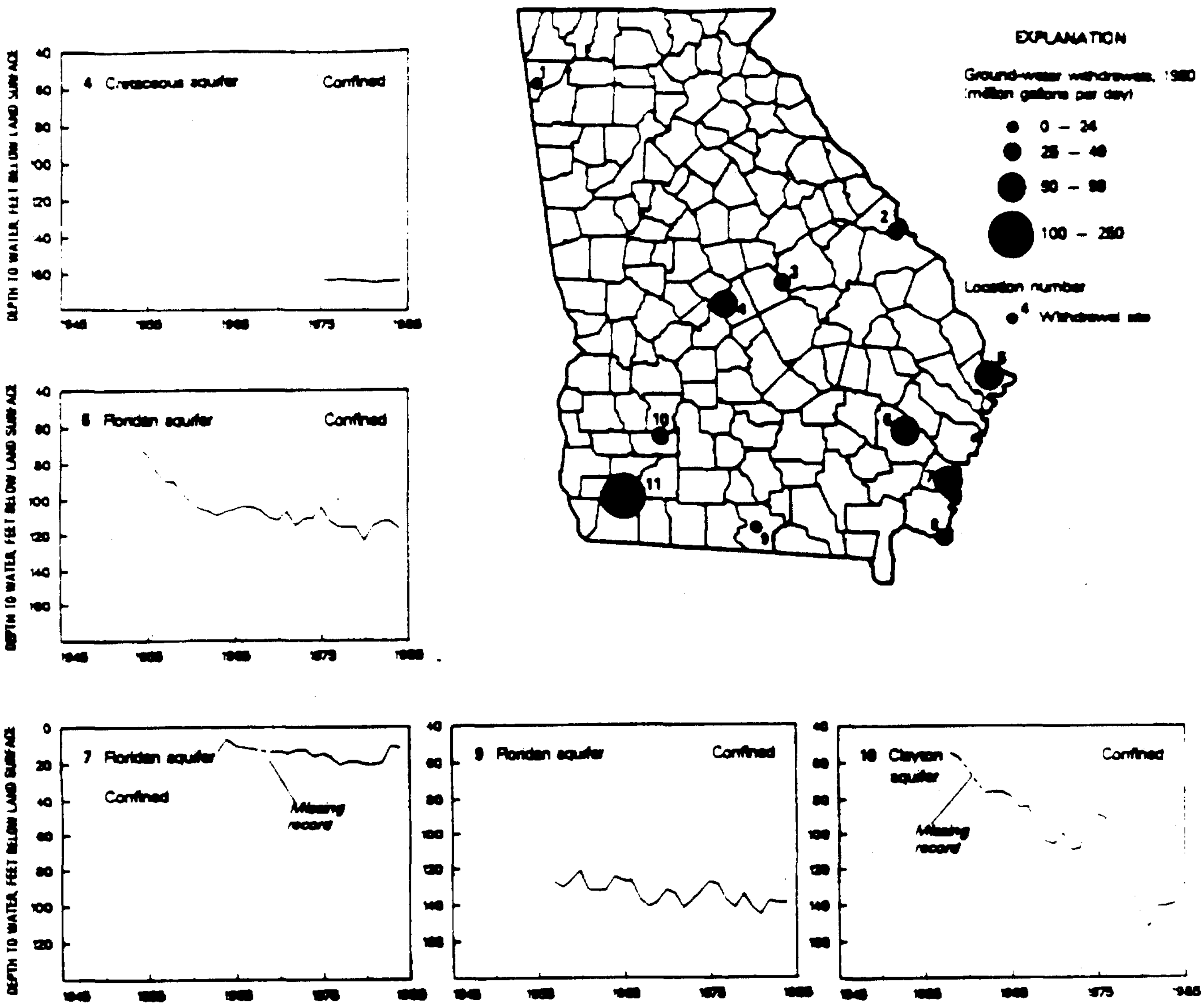
The hydrographs shown in figure 2 reflect the responses of aquifers to pumping at selected pumping centers under a variety of hydrologic conditions. In the Floridan aquifer system, large cones of depression have formed at Savannah, Brunswick, Jesup, and St. Marys as a result of pumping for industrial and public supply. At Savannah (location 5, fig 2.), the water level has declined at least 160 feet (ft) since pumping began in the late 1800's (McCollum and Counts, 1964). The hydrograph shows that the water level declined 45 ft from 1954 to 1961 and less than 10 ft from 1961 to 1984. These changes reflect pumping patterns in the area. At Brunswick, the water level in the aquifer system declined 65 ft from predevelopment to 1964 (Wait and Gregg, 1973). The decline continued until 1982 (location 7, fig. 2), then rose about 10 ft as the result of a significant decrease in pumping by a major water user. Near Valdosta (location 9, fig. 2), the water level in the Floridan aquifer system responds to changes in recharge derived from streamflow and to local pumping. The hydrograph shows a moderate long-term response to changing recharge rates and to pumping. Pumpage from the Floridan aquifer system in the Dougherty Plain area (location 11, fig. 2) is primarily for seasonal irrigation which, averaged over the year, exceeded 200 Mgal/d in 1980. In this area, pumpage is scattered widely. Some recharge to the Floridan aquifer system occurs locally. As a result, water-levels recover annually.

In the Albany area (location 10, fig. 2), water is withdrawn from the Tertiary Floridan aquifer system, the Claiborne aquifer, and the Clayton aquifer and the Cretaceous Providence aquifer. Water-level declines of more than 100 ft have occurred in the Clayton and Providence aquifers (Clarke and others, 1983, 1984). The water level in the Clayton aquifer near withdrawal location 10 (fig. 2) generally declined from 1958 to 1984 in response to increased pumping for public supply and agriculture.

The water level in the Cretaceous aquifer system has declined more than 50 ft since 1950 in areas of heavy pumping for public supply and industrial use. However, in the Huber-Warner Robins area (location 4, fig. 2), the water level has not declined significantly from 1975 to 1984 despite a slight increase in ground-water withdrawals during that period.

GROUND-WATER MANAGEMENT

Georgia has a comprehensive set of laws governing the quality and use of ground water. The Ground-Water Use Act of 1972 provided for the permitting of withdrawals for industrial and municipal use that exceed 100,000 gallons per day (gal/d) and authorized the Georgia Environmental Protection Division to issue regulations about reporting, timing of withdrawals, abatement of saltwater encroachment, well depth and spacing, and pumping levels or rates. Amendments to the



WITHDRAWAL SITES			
No. on map	Geographic area	Aquifer	Principal uses
1	Valley and Ridge	Paleozoic.	Carpet mill industry.
2	Richmond-Burke . . .	Cretaceous. . . .	Public supply, industrial, irrigation.
3	Kaolin Belt.	. . . .do	Clay mining and processing.
4	Huber-Warner Robins.	. . . .do	Clay mining and processing, public supply.
5	Savannah	Floridan	Public supply, chemical industry, pulp and paper industry.
6	Jesup	. . . .do	Pulp and paper industry.
7	Brunswick	. . . .do	Pulp and paper industry, public supply.
8	St. Marys.	. . . .do	Pulp and paper industry.
9	Valdosta	. . . .do	Public supply, industrial.
10	Albany	Floridan, Clayton, Claiborne, Providence.	Public supply, industrial, irrigation.
11	Dougherty Plain. . . .	Floridan	Irrigation.

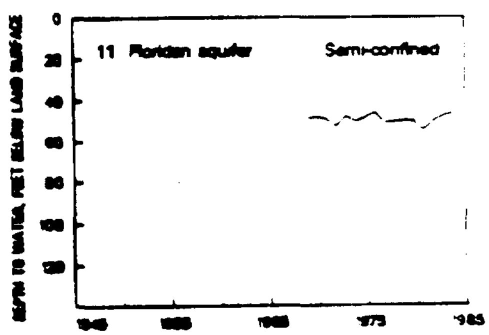


Figure 2. Areal distribution of major ground-water withdrawals and graphs of annual greatest depth to water in selected wells in Georgia. (Sources: Withdrawal data from Pierce and others, 1982; water-level data from U.S. Geological Survey files.)

REFERENCE #

R. Allan Freeze

Department of Geological Sciences
University of British Columbia
Vancouver, British Columbia

John A. Cherry

Department of Earth Sciences
University of Waterloo
Waterloo, Ontario

GROUNDWATER

Prentice-Hall, Inc.
Englewood Cliffs, New Jersey 07632

If a temperature gradient can cause fluid flow as well as heat flow in a porous medium, it should come as no surprise to find that a hydraulic gradient can cause heat flow as well as fluid flow. This mutual interdependency is a reflection of the well-known thermodynamic concept of *coupled flow*. If we set $dh/dl = i_1$ and $dT/dl = i_2$, we can write a pair of equations patterned after Eq. (2.22):

$$v_1 = -L_{11}i_1 - L_{12}i_2 \tag{2.23}$$

$$v_2 = -L_{21}i_1 - L_{22}i_2 \tag{2.24}$$

where v_1 is the specific discharge of *fluid* through the medium and v_2 is the specific discharge of *heat* through the medium. The L's are known as *phenomenological coefficients*. If $L_{12} = 0$ in Eq. (2.23), we are left with Darcy's law of groundwater flow and L_{11} is the hydraulic conductivity. If $L_{21} = 0$ in Eq. (2.24), we are left with Fourier's law of heat flow and L_{22} is the thermal conductivity.

It is possible to write a complete set of coupled equations. The set of equations would have the form of Eq. (2.23) but would involve all the gradients of Eq. (2.21) and perhaps others. The development of the theory of coupled flows in porous media was pioneered by Taylor and Cary (1964). Olsen (1969) has carried out significant experimental research. Bear (1972) provides a more detailed development of the concepts than can be attempted here. The thermodynamic description of the physics of porous media flow is conceptually powerful, but in practice there are very few data on the nature of the off-diagonal coefficients in the matrix of phenomenological coefficients L_{ij}. In this text we will assume that groundwater flow is fully described by Darcy's law [Eq. (2.3)]; that the hydraulic head [Eq. (2.18)], with its elevation and pressure components, is a suitable representation of the total head; and that the hydraulic conductivity is the only important phenomenological coefficient in Eq. (2.21).

2.3 Hydraulic Conductivity and Permeability

As Hubbert (1956) has pointed out, the constant of proportionality in Darcy's law, which has been christened the hydraulic conductivity, is a function not only of the porous medium but also of the fluid. Consider once again the experimental apparatus of Figure 2.1. If Δh and Δl are held constant for two runs using the same sand, but water is the fluid in the first run and molasses in the second, it would come as no surprise to find the specific discharge v much lower in the second run than in the first. In light of such an observation, it would be instructive to search for a parameter that can describe the conductive properties of a porous medium independently from the fluid flowing through it.

To this end experiments have been carried out with ideal porous media consisting of uniform glass beads of diameter d. When various fluids of density ρ and dynamic viscosity μ are run through the apparatus under a constant hydraulic gradient dh/dl, the following proportionality relationships are observed:

$$v \propto d^2$$

$$v \propto \rho g$$

$$v \propto \frac{1}{\mu}$$

Together with Darcy's original observation that $v \propto -dh/dl$, these three relationships lead to a new version of Darcy's law:

$$v = -\frac{Cd^2\rho g}{\mu}\frac{dh}{dl} \tag{2.25}$$

The parameter C is yet another constant of proportionality. For real soils it must include the influence of other media properties that affect flow, apart from the mean grain diameter: for example, the distribution of grain sizes, the sphericity and roundness of the grains, and the nature of their packing.

Comparison of Eq. (2.25) with the original Darcy equation [Eq. (2.3)] shows that

$$K = \frac{Cd^2\rho g}{\mu} \tag{2.26}$$

In this equation, ρ and μ are functions of the fluid alone and Cd^2 is a function of the medium alone. If we define

$$k = Cd^2 \tag{2.27}$$

then

$$K = \frac{k\rho g}{\mu} \tag{2.28}$$

The parameter k is known as the *specific* or *intrinsic permeability*. If K is always called hydraulic conductivity, it is safe to drop the adjectives and refer to k as simply the permeability. That is the convention that will be followed in this text, but it can lead to some confusion, especially when dealing with older texts and reports where the hydraulic conductivity K is sometimes called the *coefficient of permeability*.

Hubbert (1940) developed Eqs. (2.25) through (2.28) from fundamental principles by considering the relationships between driving and resisting forces on a microscopic scale during flow through porous media. The dimensional considerations inherent in his analysis provided us with the foresight to include the constant g in the proportionality relationship leading to Eq. (2.25). In this way C emerges as a dimensionless constant.

The permeability k is a function only of the medium and has dimensions $[L^2]$. The term is widely used in the petroleum industry, where the existence of gas, oil, and water in multiphase flow systems makes the use of a fluid-free conductance parameter attractive. When measured in m^2 or cm^2, k is very small, so petroleum engineers have defined the *darcy* as a unit of permeability. If Eq. (2.28) is substituted in Eq. (2.3), Darcy's law becomes

$$v = \frac{-k\rho g}{\mu}\frac{dh}{dl} \tag{2.29}$$

Referring to this equation, 1 darcy is defined as the permeability that will lead to a specific discharge of 1 cm/s for a fluid with a viscosity of 1 cp under a hydraulic gradient that makes the term $\rho g\, dh/dl$ equal to 1 atm/cm. One darcy is approximately equal to 10^{-8} cm^2.

In the water well industry, the unit gal/day/ft^2 is widely used for hydraulic conductivity. Its relevance is clearest when Darcy's law is couched in terms of Eq. (2.4):

$$Q = -K\frac{dh}{dl}A$$

The early definitions provided by the U.S. Geological Survey with regard to this unit differentiate between a laboratory coefficient and a field coefficient. However, a recent updating of these definitions (Lohman, 1972) has discarded this formal differentiation. It is sufficient to note that differences in the temperature of measurement between the field environment and the laboratory environment can influence hydraulic conductivity values through the viscosity term in Eq. (2.28). The effect is usually small, so correction factors are seldom introduced. It still makes good sense to report whether hydraulic conductivity measurements have been carried out in the laboratory or in the field, because the methods of measurement are very different and the interpretations placed on the values may be dependent on the type of measurement. However, this information is of practical rather than conceptual importance.

Table 2.2 indicates the range of values of hydraulic conductivity and permeability in five different systems of units for a wide range of geological materials. The table is based in part on the data summarized in Davis' (1969) review. The primary conclusion that can be drawn from the data is that hydraulic conductivity varies over a very wide range. There are very few physical parameters that take on values over 13 orders of magnitude. In practical terms, this property implies that an order-of-magnitude knowledge of hydraulic conductivity can be very useful. Conversely, the third decimal place in a reported conductivity value probably has little significance.

Table 2.3 provides a set of conversion factors for the various common units of k and K. As an example of its use, note that a k value in cm^2 can be converted to one in ft^2 by multiplying by 1.08×10^{-3}. For the reverse conversion from ft^2 to cm^2, multiply by 9.29×10^2.

Table 2.2 Range of Values of Hydraulic Conductivity and Permeability

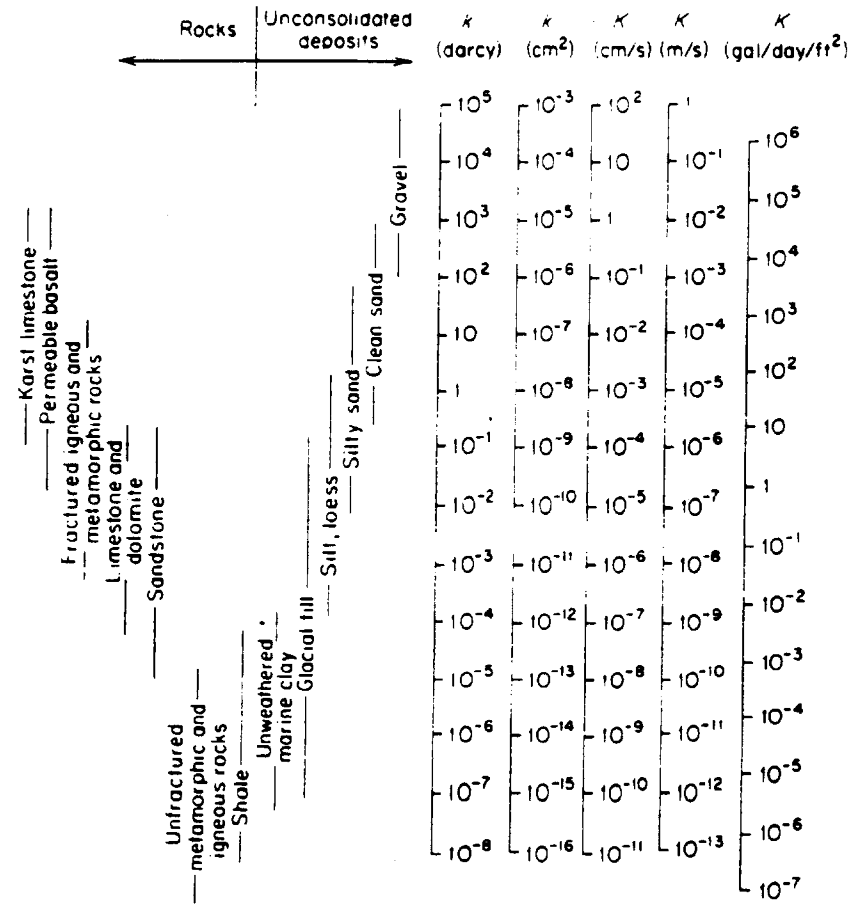


Table 2.3 Conversion Factors for Permeability and Hydraulic Conductivity Units

	Permeability, k*			Hydraulic conductivity, K		
	cm^2	ft^2	darcy	m/s	ft/s	U.S. gal/day/ft^2
cm^2	1	1.08×10^{-3}	1.01×10^{8}	9.80×10^{2}	3.22×10^{3}	1.85×10^{9}
ft^2	9.29×10^{2}	1	9.42×10^{10}	9.11×10^{5}	2.99×10^{6}	1.71×10^{12}
darcy	9.87×10^{-9}	1.06×10^{-11}	1	9.66×10^{-6}	3.17×10^{-5}	1.82×10^{1}
m/s	1.02×10^{-3}	1.10×10^{-6}	1.04×10^{5}	1	3.28	2.12×10^{6}
ft/s	3.11×10^{-4}	3.35×10^{-7}	3.15×10^{4}	3.05×10^{-1}	1	6.46×10^{5}
U.S. gal/day/ft^2	5.42×10^{-10}	5.83×10^{-13}	5.49×10^{-2}	4.72×10^{-7}	1.55×10^{-6}	1

*To obtain k in ft^2, multiply k in cm^2 by 1.08×10^{-3}.

Ground Water of the Piedmont and Blue Ridge Provinces in the Southeastern States

By H. E. LeGrand

GEOLOGICAL SURVEY CIRCULAR 538

Washington 1967

CONTENTS

ILLUSTRATIONS

TABLES

Ground Water of the Piedmont and Blue Ridge Provinces in the Southeastern States

By H. E. LeGrand

INTRODUCTION

This circular summarizes the underground water conditions in the Piedmont and Blue Ridge provinces of the Southeastern States—the region shown on the geologic map (fig. 1).

There are several ways of developing water from the ground in this region. In earlier days springs were used because they are common in coves or on lowland slopes. Almost all springs in the region yield between ½ to 3 gallons per minute and rarely show a significant decline in yield during dry weather. Dug wells were common in the past, but they are being replaced by bored and drilled wells. Bored wells, like dug wells, are as much as 2 feet in diameter and are commonly lined with concrete or terra cotta pipe; these wells do not extend into hard rock and go dry if the water table falls below the bottom of the well. Drilled wells, which are now the most common source of ground-water supply and which are the chief concern of this report, are cased to the hard rock and extend as open holes into the rock. Although some drilled wells are as small as 3 inches in diameter and others are as large as 10 inches, the most common size is about 5 or 6 inches. Almost every well in recent years has been properly constructed to prevent water on the ground from running down the outside of the casing into the well.

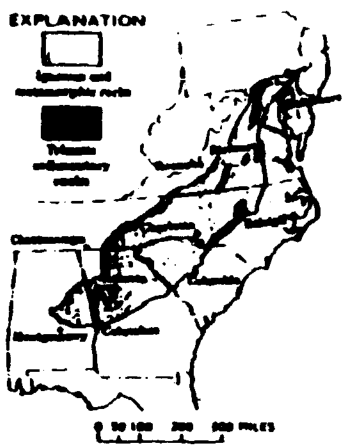


Figure 1.—Generalized geologic map. Areas underlain by igneous and metamorphic rocks are better suited to numerical rating of well sites than areas underlain by Triassic sedimentary rocks.

EVALUATING SITES

A special attempt is made to help those who are interested in the yields of wells. Because yields of individual wells in the region vary greatly within distances as short as 100 feet, estimates of potential yields of prospective wells are difficult to make. This fact has led frequently to water shortages, excessive costs, inconveniences, or undue anxiety in many cases. As the yield of a well is unpredictable, the next best approach is to attempt to show, on a percentage basis, the chance for a certain yield from a well for different conditions.

Although many factors determine the yield of a well, two ground conditions, when used together, serve as a good index for rating a well site. These conditions are topography and soil thickness. The ratings are based on the following statement: High-yielding wells are common where thick residual soils and relatively low topographic areas are combined, and low-yielding wells are common where thin soils and hilltops are combined. By comparing conditions of a site according to the topographic and soil conditions one gets a relative

rating value. For example, the following topographic conditions are assigned point values:

Points	*Topography*
0	Steep ridge top
2	Upland steep slope
4	Pronounced rounded upland
5	Midpoint ridge slope
7	Gentle upland slope
8	Broad flat upland
9	Lower part of upland slope
10	Valley bottom or flood plain
18	Draw in narrow catchment area
20	Draw in large catchment area

Figure 2 shows values for certain topographic conditions. Figure 3 shows rating values for soil thickness. The soil zone in this report includes the normal soils and also the relatively soft or weathered rock. The topographic conditions and soil conditions are separately rated, and the points for each are added to get the total points which may be used in table 1 to rate a site.

Using two well sites, A and B, as examples, we can evaluate each as to the potential yield of a well. Site A, a pronounced rounded upland (4-point rating for topography in fig. 2) having a relatively thin soil (6-point rating for soil characteristic in fig. 3), has a total of 10 points. In table 1 the average yield for site A is 6 gpm (gallons per minute). This site has a 65-percent chance of yielding 3 gpm and a 40-percent chance of yielding 10 gpm. Site B, a

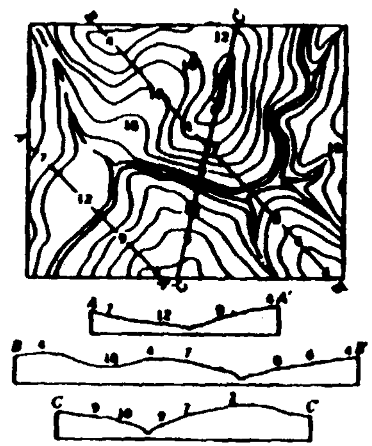
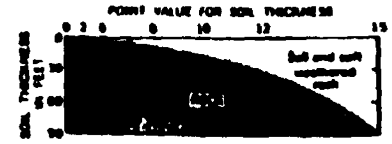


Figure 2.—Topographic map and profiles of ground surface showing rating in points for various topographic positions.



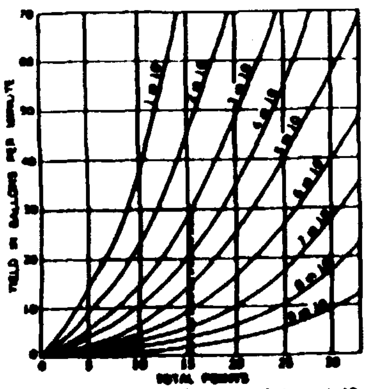
POINT VALUE	CHARACTER OF SOIL AND ROCK
0-2	Bare rock—almost no soil
2-6	Very thin soil—some rock outcrops
6-9	Soil thin—a few rock outcrops
9-12	Moderately thick soil—no fresh outcrops
12-15	Thick soil—no rock outcrops

Figure 3.—Rating in points for various conditions of soil thickness.

Table 1.—*Use of numerical rating of well site to estimate the percent chance of success of a well*

[Data are based on maximum depth of 300 feet or maximum drawdown of water level of about 200 feet. No interference from pumping is assumed. Numerical rating is obtained by adding rating in points for topography and soil thickness]

Total points of a site	Average yield (gpm)	Chance of success, in percent, for a well to yield at least—				
		3 gpm	10 gpm	25 gpm	50 gpm	75 gpm
5	2	48	18	6	2	......
6	3	50	20	7	3	......
7	3	55	25	8	3	......
8	4	55	30	11	3	......
9	5	60	35	12	4	......
10	6	65	40	15	5	......
11	7	70	43	18	7	......
12	9	73	46	22	10	......
13	11	77	50	26	12	......
14	12	80	53	30	14	......
15	14	83	54	33	16	......
16	16	85	57	36	18	......
17	17	86	60	40	20	13
18	20	87	63	45	24	15
19	23	88	66	50	25	18
20	26	89	70	53	27	20
21	28	90	72	54	30	22
22	31	91	74	56	35	24
23	34	92	76	58	38	26
24	37	92	78	60	40	29
25	39	93	80	62	43	32
26	41	93	81	64	46	36
27	43	94	82	66	48	40
28	45	95	83	68	50	42
29	48	95	84	71	53	44
30	50	96	87	73	56	47
30+	50	97	91	75	60	50



Example: A site with 16 points has 3 chances in 10 of yielding at least 20 gallons per minute and 6 chances in 10 of yielding 10 gallons per minute.

Figure 4.—Probability of getting a certain yield from a well at different sites having various total-point ratings.

draw or slight sag in topography (18-point rating) having a moderately thick soil (12-point rating), has a total of 30 points, an average yield of 30 gpm, and a 73-percent chance of yielding 25 gpm. Referring to figure 4, we see that the 10-point site has less than 1 chance in 10 of yielding 40 gpm whereas the 30-point site has better than an even chance of yielding 40 gpm.

Some topographic conditions of the region and a few topographic ratings are shown in figure 5. Wells located on concave slopes are commonly more productive than wells on convex slopes or straight slopes. Broad but slight concave slopes near saddles in gently rolling upland areas are especially good sites for potentially high-yielding wells. On the other hand, steep V-shaped valleys of the gully type may not be especially good sites, and they should be avoided if surface drainage near the well is so poor that contamination is possible.

More difficulty is likely to occur in rating character of soil and rock than in rating

Figure 5.—Countryside in the Blue Ridge province showing approximate ratings for topography.

Figure 6.—The soil zone is likely very thin over these rock outcrops (soil-thickness rating 0 to 4 points).

topography. Everyone should be able to determine by observation if the soil is thin (less than 7 soil and rock points as shown in figure 6) and if the soil is fairly thick (more than 10 soil and rock points), but the intermediate ratings are difficult to make. If the observer is unsure of the soil and rock rating above the 6-point (thin soil) value he may choose a 10-point value for the site with assurance that he is fairly correct. White quartz of flint, which occurs as veins and as rock fragments on the ground, is not considered a true rock in this report because it persists in the soil zone; a quartz vein in many cases is considered to be a slightly favorable indication of a good well site.

The numerical rating system is not intended to be precise. One person may rate a particular site at 15 points, whereas another person may rate it at 17 points; such a small difference in rating would not be misleading. Almost everyone's rating will be within 5 points of an average rating for a site.

YIELD

The term "yield" is not definite but is the reported capacity of a well to produce water, generally during a short pumping test. The water level in a well will stabilize if a certain limited yield or withdrawal of water is maintained; however, a greater withdrawal or yield will cause the water level to fall. In many cases the water level continues to fall until the pumping stops so that continuous pumping would result in a smaller yield than that estimated earlier. The percentage of relative yield is not directly proportionate to the percentage of drawdown of the water level, but the greater percentage of yield is reached before the greater percentage of drawdown. Figure 7 shows an approximate relation of drawdown to yield for an average well in the region. Note that the yield-drawdown relationships of all wells lie within the shaded zone and that average conditions occur on or near the heavy line. As an example of the relation between yield and drawdown, we may consider a well 320 feet deep having a static water level of 20 feet below land surface. (See fig. 6.) This well yields 40 gpm with a pumping level at a depth of nearly 220 feet; the pump might better be set at 130 feet (30 percent of drawdown or half the thickness of the water) where about 30 gpm or 80 percent of the relative yield could be realized. It is unnecessary and uneconomical to lower the water level of a well to a position near the bottom unless the yield is so poor that the water stored in the well is needed.

There is no simple definition of the yield of a well—especially in the Blue Ridge and Piedmont provinces. Yields for various levels of the water in the pumped well are rarely known. The yields in this report are considered to be standard for wells about 300 feet deep which are pumped about 12 hours each day and in which drawdown of the water level is about 200 feet; it is assumed that there is no interference by pumping from other wells, which would increase drawdown.

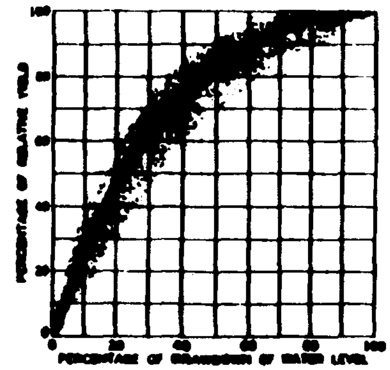


Figure 7.—The curve shows that an increase in yield of a well is not directly proportional to an increase in drawdown of the water level. A yield of nearly 80 percent of the total capacity of a well results from lowering the water level only 40 percent of the available drawdown.

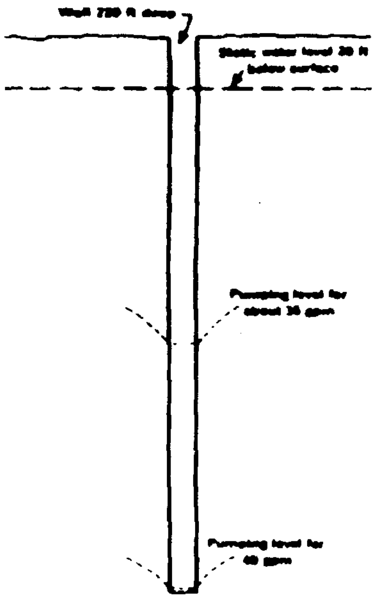


Figure 8.—Yield of a well at two different pumping rates.

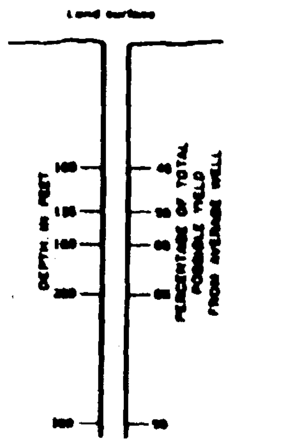


Figure 9.—Rate at which deepening of average well increases the yield.

DEPTH OF WELLS

How deep should a well be drilled? This question is not easy to answer for an individual well. In most places fractures in the rock get smaller and fewer with depth and deep drilling may not be economical. Figure 9 shows the percentage of total yield for certain depths in an average well.

The following table shows the percentage of wells that reach their maximum yields at certain depths below which drilling is useless. As

Depth (feet)	Percentage of wells
[illegible]	[illegible]
100	[illegible]
150	[illegible]
200	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

most of the interconnecting fractures occur in a zone no deeper than 150 feet below the land surface, it may be wise to drill no deeper than 150 feet if the yield is very poor, or no deeper than 300 feet in almost all cases.

FRACTURES IN THE ROCK

Figure 10 illustrates six different fracture patterns in rocks penetrated by wells. To simplify the illustrations the water table and soil thickness are considered uniform, and each well, cased to 50 feet, is 200 feet deep. The approximate number of times each general pattern of fractures occurs in 100 wells is shown in percentage beneath each type. Well A penetrates no fractures below the casing; therefore, the well yields no water. Well B penetrates a fracture zone in which two or more fractures occur a few feet below the casing. This type of well is common. It may yield as much as 10 to 20 gpm for a period of several minutes until the fractures are drained. Then its yield will likely decline suddenly, and the amount of decline will depend upon the amount of water transmitted to the well by the soil and the underlying thin zone of fractured rock. That part of the well below the fracture zone contributes no water and acts only as a storage reservoir into which water drains. The yield of this well does not increase with increased drawdown. Well C penetrates only one fracture, a large one near the top of the fresh rock. This well is similar to well B. It may yield considerable water for a few minutes until the stored water in the fracture is drained. The perennial yield, under continuous pumping, will depend on the permeability of the soil and weathered rock and on the amount of water that is released to the fracture. Well D penetrates several fractures, which contribute small amounts of water, and a large fracture at a depth of about 90 feet. Well E penetrates several small- to medium-sized fractures. These fractures are larger and more closely spaced in the upper part of the bedrock. Well F penetrates only one fracture—a large one below a depth of 300 feet.

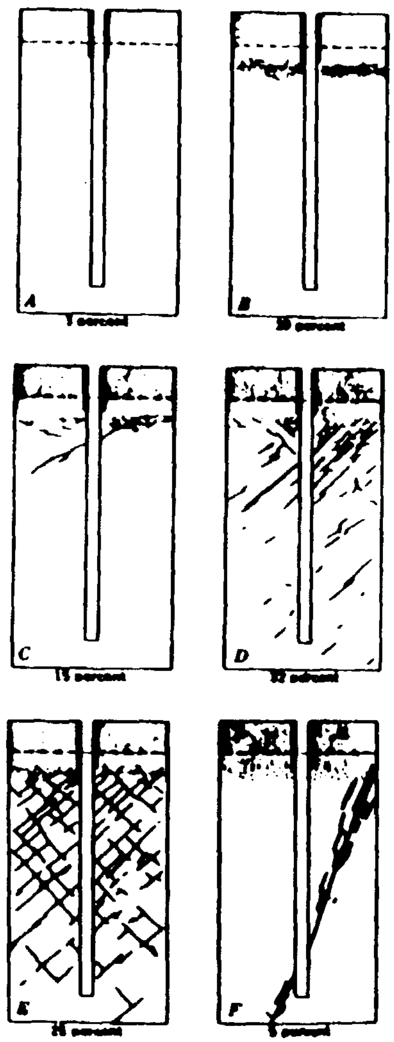


Figure 10.—Six types of ground conditions showing distribution of fractures that influence the yields of wells. The stippled pattern represents soil and soft rocks; the dashed line is the water table. The degree of frequency of the different types is shown in percentage.

WATER TABLE

The water table, or upper surface of the underground reservoir, continuously fluctuates and reflects changes in underground storage. During droughts we see evidence of a falling water table when many shallow wells go dry. We also can detect a lowering of the water table locally around wells from which water is pumped. There is a continual discharge of ground water by seepage into streams, by evaporation, and by transpiration through vegetation. The discharge causes a gradual lowering of the water table except for periods during and immediately after significant precipitation when recharge to the underground reservoir exceeds the discharge from it and the water table rises. Figure 11 shows the trends of water-level fluctuation in a well at Chapel Hill, N. C. The water level in this well is controlled entirely by natural conditions, and its fluctuation is typical of that in the region. There is a characteristic seasonal change in the water table, which begins to decline in April or May owing to the increasing amount of evaporation and transpiration of plants. In November or December, when much of the vegetation has become dormant, the precipitation first makes up the summertime soil-moisture deficiency and then again becomes effective in producing recharge, and the water table begins to rise. In a year of normal rainfall the recharge to the underground reservoir is approximately equal to the discharge from it, so that the water table

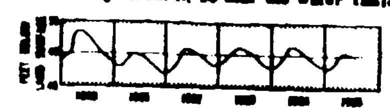


Figure 11.—The water table generally declines in summer and fall and rises to a high level in early spring, as shown by the record of this well in Chapel Hill, N. C.

Table 2.—Concentrations of chemical constituents and their characteristic effects on water use in the region

[Concentration in parts per million except as indicated. Occurrence, where noted, is given in parenthesis after concentrations]

Constituents	Concentration	Characteristic effects on water use
Silica (SiO_2)	Rarely less than 15 or more than 45, commonly 20 to 35.	Forms hard scale in pipes and boilers but not normally a serious problem in the region.
Iron (Fe)	Commonly less than 0.3 in natural water, but corrosion of iron pipes from water with pH less than 6.0 causes a fairly common iron problem.	More than 0.3 ppm stains laundry, utensils, and fixtures reddish brown.
Calcium (Ca) and magnesium (Mg)	Rarely less than 5 or more than 80 (commonly 5 to 20 in water beneath light-colored soils and 15 to 50 in water beneath dark-colored soils).	Cause most of the hardness and scale-forming properties of water. (See hardness below.)
Bicarbonate (HCO_3)	Rarely less than 15 or more than 150, commonly 30 to 100.	Concentrations in region are not generally high enough to cause trouble.
Sulfate (SO_4)	Rarely less than 1 or more than 100, commonly 1 to 40.	Concentrations in region are not generally high enough to cause trouble.
Chloride (Cl)	Rarely less than 1 or more than 40, commonly 1 to 20.	Salty taste in water having more than a few hundred parts per million.
Fluoride (F)	Rarely more than 1 commonly 0.0 to 0.6.	Concentration between 0.6 and 1.7 ppm in water retards decay of teeth, but amounts in excess of 1.5 ppm may cause mottled enamel of teeth.
Nitrate (NO_3)	Rarely more than 20 commonly less than 10.	Where concentration is greater than 20 ppm, contamination from sewage may be suspected. Water of concentrations greater than 45 ppm may be harmful to babies.
Dissolved solids	Total of all mineral matter rarely exceeds 250, commonly 70 to 150.	Water containing more than 1,000 ppm of dissolved solids is unsuitable for most purposes.
Hardness as equivalent $CaCO_3$	Rarely less than 10 or more than 130 (commonly 10 to 30 in water beneath light-colored soils and 40 to 200 in water beneath dark-colored soils).	Causes consumption of soap before lather will form. Hard water forms scale in boilers and hot water heaters. Water whose hardness is less than 60 ppm is considered soft; 61 to 120 ppm, moderately hard; 121 to 180 ppm, hard; more than 180 ppm, very hard.
pH	Rarely less than pH of 5.5 or more than 7.5 (commonly 5.5 to 6.0 in water beneath light-colored soils and 6.0 to 7.5 in water beneath dark-colored soils).	Values less than 7.0 indicate acidity, and corrosiveness of water generally increases with decreasing pH.

at the end of the year is at about the same level as at the beginning of the year. Wells drilled into rock may, when pumped at full capacity, yield slightly less during the driest part of the year when the water table is low. Yet there appears to be no evidence to support the general belief that the water table has been declining during recent years.

CHEMICAL QUALITY OF THE WATER

In comparison with ground water in widely scattered regions of the world, the water in the Piedmont and Blue Ridge provinces ranks among the best in chemical quality. (See table 2.) Most of the water is low in total dissolved solids and is generally soft, but some is moderately hard.

Iron in water is the most common complaint. As little as 0.4 ppm (parts per million) will cause a red stain on plumbing fixtures. About 5 of every 10 wells yield water with less than 0.3 ppm of iron. About 4 of 10 wells yield water with just enough iron to cause a slight stain, and about 1 of 10 wells yields water that has considerable iron. Some iron problems result when iron is dissolved from rocks, and other problems result when water, moving through iron pipes, consequently picks up a brown iron stain by corrosion. It is important to determine the source of the iron, whether dissolved from the rocks or from the pipes, before methods for its removal are employed. Most of the water is satisfactory for use without any type of treatment (table 2). Yet an analysis of the water should be made as soon as a well is drilled to determine if treatment is necessary. It is not possible to determine the quality of water before a well is drilled.

CONTAMINATION OF GROUND WATER

In view of the many hundreds of thousands of wells that are interspersed with about an equal number of septic tanks and other waste sites, it is proper to give serious attention to the possibility of contaminating an individual water supply. The tendency for ground water—and contaminants that might be in it—to move naturally from upland areas toward stream valleys offers help in planning wells and waste sites to avoid contamination. A well that is pumped may modify the natural movement of water and draw contaminated water toward it; this condition is more likely where the soil is thin or absent than where it is thick. Care should be taken to see that no water from the land surface can seep easily into the well around the casing. Not only is the well site important but so is the waste site. In most cases, the chances of contaminated water from a waste site moving into a well are not easy to predict, but a few general statements can be made. For example, at a waste site (1) a deep water table is safer than a shallow water table, (2) thick soil is safer than thin soil or rock outcrops, (3) sandy soil with some clay may be better than a clean sandy soil or a sticky clay soil, and (4) a slope of both the land surface and the water table away from a well is better than one toward it.

The soil and weathered rock are generally effective in preventing waste materials from passing through to underlying rock fractures, but the combination of (1) certain types of wastes, (2) excessive quantities of disposed wastes, and (3) thin soils may result in contaminated water reaching bedrock fractures. Once in the bedrock fractures the contaminated water may move easily to water supplies. Only a small percentage of wells have been contaminated, but proper care in locating and constructing wells and waste sites must be taken to minimize the risk of contamination. Minimum standards specified by health officials, such as those relating to permeability of the soil, distance between a well and a waste site, and depth of the water table, must be followed.

GENERAL STATEMENTS ABOUT GROUND WATER IN THE REGION

1. Ground water may be considered as occurring in an underground reservoir, the water being held in the open spaces of the rock materials. The water table, representing the top of the reservoir, generally lies in the clay, or disintegrated rock materials. In the lower part of the reservoir, water occurs in interconnecting fractures in bedrock, the fractures diminish in number and size with increasing depth. Water enters the fractures by seeping through the overlying clay, and drilled wells draw water from these fractures. The source of this water is precipitation in the general area of a well and not in some remote place.

2. A layer of residual soil and weathered rock lies on the fresh rock in most places; the thickness of the soil and weathered rock ranges from zero to slightly more than 150 feet.

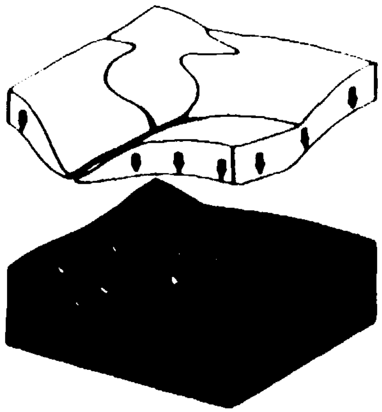


Figure 1[illegible].—Dry area (above water table) [illegible] up to [illegible] water table at surface of saturated area. Movement of water (arrows) tends to be downward in the dry area and lateral toward streams in the saturated zone.

3. The water table has a hill and valley relation that approximately conforms with surface topography, although the water table is somewhat flatter. (See fig. 12.) For example, a creek or river is the surface expression of the water table in a valley, but beneath a hill the water table may be 30 to 70 feet below the ground surface. Ground water, like surface water, has the tendency to drain away from the hills to the valleys. This tendency helps in planning the location of wells in relation to other wells and to sources of possible contamination.

4. A close network of streams prevails, and in most places on an upland area a perennial stream is less than 1 mile away.

5. Toward the streams is a continuous flow of ground water. Some of the outflowing ground water is used up by evaporation and by transpiration of plants in the valley areas, the remainder of the water discharges as small springs and as bank and channel seepage into the streams.

6. The natural movement of ground water is relatively short and is almost everywhere restricted to the area underlying the gross topographic slope extending from a particular land-surface divide to the adjacent streams.

7. In ideal cases the pumping of a well causes the water table to be depressed smoothly in the shape of an inverted cone, the apex of the cone being in the well; however, the erratic distribution of rock fractures and the contrasting nature of permeability between rock fractures and overlying soils cause the depressed part of the water table to extend unevenly around a well. Where two heavily pumped wells are within a few hundred feet of each other, there is a strong likelihood of some interference of pumping level between the two, but in most cases there is not any appreciable interference between low-yielding wells a few hundred feet apart. From a pumped well the depressed part of the water table rarely extends beneath a perennial stream or beneath a hilltop to a slope on the opposite side. Well interference is local, and there is no regional lowering of the water table because of pumping.

8. The relation of the depth of a well to yield of the aquifer is not simple. In spite of some beliefs, water already available to a well is rarely lost by drilling deeper; therefore, there is always a chance of getting a larger supply by increasing the depth of the well. Yet this chance becomes poorer as the well deepens because the interconnecting fractures and the ability of the rocks to store and transmit water decrease significantly with depth. More than 90 percent of all ground water occurs in the first 100 feet below the water table. Generally two wells 300 feet deep each will yield more water than one well 600 feet deep.

9. The relationship of topography to yield is emphasized. The great majority of wells are located on hills or smooth upland slopes because of convenience and because these locations appear safe from sources of contamination. Yet the percentage of low-yielding wells is much greater on hills and upland convex slopes than in lowlands or draws (concave slopes that lead upward from a valley to a saddle or sway-backed position in a ridge). Steep-sided depressions, such as gullies and ravines, should not be considered acceptable sites for wells.

10. In general, wells are more productive and tend to have a more stable year-round yield where there is a thick mantle of soil than where bare rock crops out. The presence of a soil cover and the absence of rock outcrop suggest that water moves downward into the rock and is not readily shunted toward the adjacent valley. In fact, the soil cover suggests that interconnecting rock fractures are available to store water and to transmit it to wells. Where there is a good soil cover, the water table generally lies in it; therefore, the storage capacity in the vicinity is much greater than where bare rock is exposed and where the only water in storage is in the rock fractures that might be quickly drained.

11. Simple clear-cut statements about the water-yielding properties of the various types of rocks are not easy to make. There are many varieties of igneous and metamorphic rocks, but for a discussion of their ground-water properties they may be grouped as follows: (1) Somewhat massive igneous rocks, such as granite, and (2) metamorphic rocks, such as schists, gneisses, and slates, which may show an alinement of minerals or an alinement of cleavage planes or openings along which water may move. In some places a type of rock may have distinctive water-bearing characteristics, but, if so, it is also likely to show distinctive topographic and soil-mantle features. Topography and soil-mantle features are readily observed and may be used as criteria for predicting the water-yielding potential of a well site, whereas the water-bearing characteristics of a type of rock by itself may be obscure. At any rate, there are too many complex factors involved to justify generalizations about the yield of wells in individual types of rock.

12. Whenever water is pumped from a well, the water level is lowered in and around the well. The drawdown increases with an increase in the rate of pumping, although this relation is not simple. For example, a well yielding 30 gpm with a drawdown of 50 feet will not double its yield by increasing the drawdown to 100 feet. Instead, it will yield less than 60 gpm and perhaps no more than 35 to 39 gpm with a drawdown of 100 feet.

13. Some wells that are pumped heavily tend to decline gradually in yield. This fact may be due to the following circumstances. The size and setting of a pump are determined from a short bailer or pumping test when the well is completed. Such a short test may not indicate the long-term yield of the well because the first water is withdrawn from storage in the rock materials, and many hours, days, or even months may pass before there is a stable adjustment between the amount of water that the fractures can feed into the well and the amount of water available to drain through the overlying clay into the fractures feeding the well. Failure to have knowledge of water level fluctuations as a result of pumping is the cause of many well problems and of the erroneous conclusion that well supplies are not dependable. If a well tends to have an unstable yield, it is probably overpumped. A reduction in the rate of pumping and consequently a raising of the water level will result in a perennially safe yield. Constant pumping at a moderate rate does not damage a well.

14. There is a tendency for rocks underlying a light-colored soil to yield water that is low in dissolved mineral matter and is soft. On the other hand, rocks underlying darker soils (dark red, brown, and yellow) tend to yield water that is slightly hard, or hard, and that may contain objectionable amounts of iron.

15. Many people think that a shallow depth to the water table is an indication of a good yield of a potential well, but this is not a rule to follow. In fact, where the water table is only a few feet beneath the land surface on an upland area, the rock fractures may be so scarce that water may not be able to move downward in the rock; it is held near the ground surface and perhaps is shunted out to the land surface as a wet seepage spot on a steep slope.

16. There are many mistaken notions about the availability of ground water in the region. These notions arise from lack of knowledge of the occurrence and movement of ground water and of the behavior of wells. The common erroneous statement that a certain town in the region could not depend on well water alone from the existence of a limited number of wells; never has the underground reservoir beneath any town or city in the region been completely depleted of its water. There has been a tendency for towns of about 1,000 people to convert from well supplies to a treated surface-water supply; such conversion commonly occurs when the town requires more than 300,000 gallons of water per day, an amount which only a few wells in aggregate may not produce. Few towns have the experienced persons with diversified knowledge of wells and ground-water conditions to provide the good management comparable to that of municipal surface-water supplies.

SOURCES OF INFORMATION

There are many sources of information about ground-water conditions in specific parts of the region. At least one agency in each State has cooperated financially with the U.S. Geological Survey, and these agencies have contributed in some way to the results of this report. Further information about reports published or work in progress may be obtained from the district offices of the Geological Survey in each State or from the respective State cooperating agencies.

NUS CORPORATION AND SUBSIDIARIES

REFERENCE (30

CONTROL NO F4-8907-44	**DATE:** November 7, 1989	**TIME:** 1540

DISTRIBUTION:

ESB Inc

BETWEEN: Dennis Swanson	**OF:** Atlanta Water Bureau	**PHONE:** (404) 658-7768

AND: Doug Chatnam, NUS Corporation

Rebecca Hoffman for

DISCUSSION:

Mr Swanson said that within the city limits of Atlanta, the city of Atlanta supplies all the water and that none to his knowledge ~~is~~ drawing water from wells.

REFERENCE 1 [illegible]

NUS CORPORATION AND SUBSIDIARIES

CONTROL NO F4-8907-44	**DATE:** November 8, 1989	**TIME:** 1445
DISTRIBUTION: ESB, Inc		
BETWEEN: Rodney Sams	**OF:** Atlanta Water Bureau	**PHONE:** (404) 355-8229
AND: Doug Chatham, NUS Corporation Rebecca Hoffman for		

DISCUSSION:

Mr. Sams, who works at the River Intake, said that Atlanta has one intake on the Chattahoochee on Ridgewood Road off of Moore's Mill Road at the confluence of the Chattahoochee River and Nancy Creek

REFERENCE #

NUS CORPORATION AND SUB

TELECON NOTE

CONTROL NO.	DATE: September 5, 1989	TIME: 10:00

DISTRIBUTION: Georgia Power - Plant Branch

BETWEEN: Kris Martin	OF: Natural Resources Dept. of Fisheries	PHONE: (404) 557-2591

AND: Maureen Gordon, NUS Corporation

DISCUSSION:

From Buford Dam to Peachtree Creek, no discharge is allowed as the Chattahoochee R. is a primary trout stream. South of Peachtree Creek, there is still fishing on the banks and in boats to a smaller extent. These are many species of warm stream fish with trout still being caught as far south as I-20.

FROST ASSOCIATES

P.O. Box 495, Essex, Connecticut 06426
(203) 767-1254 Fax (203) 767-7069

Jan 19, 1993

To: James Ussery
Department of Natural Resources
Environmental Protection Division
106 Butler Street SE
Atlanta, GA 30334

Fr: Bob Frost
Frost Associates
P.O. Box 495
Essex, CT 06426

Sub: U.S. Plating Burnsite
Fulton, County

Site Longitude: 84.386597
Site Latitude : 33.706600

The CENTRACTS report below identifies the population, households, and private water wells of each Block Group that lies within, or partially within, the 4, 3, 2, 1, .5, and .25, mile "rings" of the latitude and longitude coordinates above. CENTRACTS may have up to ten radii of any length. 1000 block groups, and 15000 block group sides.

CENTRACTS uses the 1990 Block Group population and Block Group house count data found in the Census Bureau's 1990 STF-1A files. The sources of water supply data are from t[illegible] Bureau's 1990 STF-3A files. The boundary line coordinates of the Block Groups were extracted from the Census Bureau's 1990 TIGER/Line Files.

CENTRACTS reports are created with programs written by Frost Associates, P.O. Box 495, Essex, Conn. The code was written using Microsoft's Quick-Basic Ver. 4.5.

Latitude and Longitude coordinates identifying a site are entered in degrees and decimal degrees. One or more county files holding Block Group boundary lines are selected for use by CENTRACTS by determining whether the site coordinates fall within the minimum and maximum Lat\Lon coordinates of each county in the state.

Each Block Group line segment has Lat\Lon coordinates representing the "From" and "To" ends of that line. All coordinates from the selected county files are read and converted from degrees, decimal degrees to X\Y miles from the site location. Each line segment is then examined whether it lies within or partially within the maximum ring from the site.

The unique Block Group ID numbers of each line segment that lie within the maximum ring are retained. All Block Group boundary lines matching the Block Group numbers are then extracted from the respective county files to obtain all sides of the in cluded Block Groups. Boundary records are then sorted in adjacent side order to determine the shape and area of each Block Group polygon.

A method to solve for the area of a polygon is to take one-half the sum of the pro ducts obtained by multiplying each X-coordinate by the difference between the adja cent Y-coordinates. For a polygon with coordinates at adjacent angles A, B, C, D, and E. The formula can be expressed:

Area = 1/2{Xa(Ye-Yb)+ Xb(Ya-Yb)+ Xc(Yb-Yd)+ Xd(Yc-Ye)+ Xe(Yd-Ya)}

For each ring, the selected Block Groups will be inside, outside, or intersected by the ring. When a polygon is intersected, the partial Block Group area within that ring is calculated using the method described below.

When a ring intersects a Block Group, the intersect points are solved and plotted at the points where the ring enters and exits the shape. The chord line, a line within the circle connecting the intersect points is determined. This chord line is used to calculate the segment area, the half moon shape between the chord line and the ring, and the sub-polygon created by the chord line and the Block Group boundaries that lie outside the ring.

The segment area is subtracted from the sub-polygon area to determine the area of the sub-polygon outside the ring. The area outside the ring is then subtracted from the area of the entire polygon to arrive at the inside area. This inside area is then divided by the tract's total area to determine the percentage of area within the ring. This process is repeated for each block group that is intersected by one of the rings. The total area, partial area, and percentage of partial area of those block groups within, or partially within a ring, are held in memory for the report.

On occasion, the algorithm described above is unable to determine the area of the partial area. Within the report program is a "Paint" routine which allows an enclosed shape to be highlighted. Another routine calculates the percentage of highlighted screen pixels to the pixels within the polygon. A manual entry is allowed. Both the "paint" method and manual entry method over ride the calculated method.

CENTRACTS lists, starting on page 4, all Block Groups in State, County, Census Tract, and Block Group ID order that lie within, or partially within, the maximum ring. Each Block Group is identified by a City or Town name and by the Block Group's State, County, Tract and Block Group ID number. Following is the Block Group's 1990 populu tion and house count extracted from the Census Bureau's 1990 STF-1A files.

The next four columns display water source data from the 1990 STF-3A files. The first column is "Units with Public system or private company source of water", followed by "Units with individual well, Drilled, source of water"; "Units with individual well, Dug, source of water" and "Units with Other source of water".

For each ring, CENTRACTS then shows the Block Groups that are within that ring, the Block Group's total area in square miles, the partial area of the Block Group within that ring, and the partial percentage within the ring. The areas of the included Block Group and the partial areas are then totaled.

The last section tallies the demographic data within each ring. The percentage of area for each Block Group is multiplied times the census data for that Block Group and totaled for all Block Group's within the ring. Ring totals are then determined by subtracting the three mile data from the four mile, the two mile from the three mile, one from the two, etc... Population on private wells is calculated using the formula: ((Drilled + Dug Wells) / Households) * Population

No.	City	Block Group ID	Blk Grp People	House Holds	Public Water	Drilled Wells	Dug Wells	Other
1	Atlanta-Decatur	13089 0205 1	2419	1012	1027	0	0	0
2	Atlanta-Decatur	13089 0205 2	1014	515	500	0	0	0
3	Atlanta-Decatur	13089 0209 1	2187	915	932	0	0	0
4	Atlanta-Decatur	13089 0209 2	1714	677	652	0	0	0
5	Atlanta-Decatur	13089 0209 3	2069	624	644	0	0	0
6	Atlanta-Decatur	13089 0209 4	1379	550	541	0	0	0
7	Atlanta-Decatur	13089 0237 4	2381	859	897	0	0	0
8	Atlanta-Decatur	13089 0237 5	429	156	132	0	0	0
9	Atlanta-Decatur	13089 0234043	837	305	290	0	0	0
10	Atlanta-Decatur	13089 0234044	58	31	15	12	0	0
11	Atlanta-Decatur	13089 0238011	814	269	267	0	0	0
12	Atlanta-Decatur	13089 0238012	1653	585	551	0	0	0
13	Atlanta-Decatur	13089 0238013	2425	923	957	0	0	0
14	Atlanta-Decatur	13089 0238021	785	183	198	0	0	0
15	Atlanta-Decatur	13089 0238022	948	64	61	0	0	0
16	Atlanta-Decatur	13089 0238023	2636	1054	1121	0	0	0
17	Atlanta-Decatur	13089 0238032	1004	311	284	0	0	0
18	Atlanta-Decatur	13089 0238033	2373	733	732	0	0	0
19	Atlanta-Decatur	13089 0238034	1686	512	478	0	0	0
20	Atlanta	13121 0017 2	431	308	298	0	0	0
21	Atlanta	13121 0017 3	413	89	90	0	0	0
22	Atlanta	13121 0018 4	692	479	518	0	0	0
23	Atlanta	13121 0018 5	453	366	371	0	0	0
[illegible]	Atlanta	13121 0018 6	30	24	16	0	0	0
25	Atlanta	13121 0019 1	404	79	74	0	0	0
26	Atlanta	13121 0019 2	211	314	318	0	0	0
27	Atlanta	13121 0021 2	232	7	3	0	0	0
28	Atlanta	13121 0021 3	2	2	0	0	0	0
29	Atlanta	13121 0022 3	38	31	29	0	0	0
30	Atlanta	13121 0022 4	531	255	263	0	0	0
31	Atlanta	13121 0024 1	510	242	225	0	0	0
32	Atlanta	13121 0024 2	668	384	365	0	0	0
33	Atlanta	13121 0024 3	197	136	137	0	0	0
34	Atlanta	13121 0024 4	473	235	207	0	0	0
35	Atlanta	13121 0024 5	655	499	504	0	0	0
36	Atlanta	13121 0025 1	322	262	282	0	0	0
37	Atlanta	13121 0025 2	874	106	100	0	0	0
38	Atlanta	13121 0025 3	420	228	191	0	0	0
39	Atlanta	13121 0025 4	130	75	69	0	0	0
40	Atlanta	13121 0025 5	1064	558	569	0	0	0
41	Atlanta	13121 0025 6	1052	471	473	0	0	0
42	Atlanta	13121 0026 1	272	137	139	0	0	7
43	Atlanta	13121 0026 2	62	85	90	0	0	0
44	Atlanta	13121 0026 3	0	0	0	0	0	0
45	Atlanta	13121 0026 4	123	63	56	0	0	0
46	Atlanta	13121 0026 5	186	97	95	0	0	0
47	Atlanta	13121 0026 6	250	162	174	0	0	0
48	Atlanta	13121 0027 1	114	0	0	0	0	0
49	Atlanta	13121 0027 2	48	11	10	0	0	0
50	Atlanta	13121 0028 1	645	480	522	0	0	0
51	Atlanta	13121 0028 2	0	0	0	0	0	0

52	Atlanta	13121	0028	3	290	181	176	0	0	0
53	Atlanta	13121	0028	4	975	578	583	0	0	0
54	Atlanta	13121	0029	1	381	212	201	0	0	0
55	Atlanta	13121	0029	2	348	242	246	0	0	0
56	Atlanta	13121	0029	3	415	207	204	0	0	0
57	Atlanta	13121	0029	4	120	117	121	0	0	0
58	Atlanta	13121	0030	1	576	330	308	0	0	0
59	Atlanta	13121	0030	2	341	177	170	0	0	0
60	Atlanta	13121	0030	3	746	421	414	0	0	0
61	Atlanta	13121	0031	1	811	377	391	0	0	0
62	Atlanta	13121	0031	2	410	185	179	0	0	0
63	Atlanta	13121	0031	3	543	222	220	0	0	0
64	Atlanta	13121	0032	1	440	233	236	0	0	0
65	Atlanta	13121	0032	2	409	184	177	0	0	0
66	Atlanta	13121	0032	3	392	250	241	0	0	0
67	Atlanta	13121	0033	1	342	201	228	0	0	0
68	Atlanta	13121	0033	2	277	161	166	0	0	0
69	Atlanta	13121	0033	3	657	447	421	0	0	0
70	Atlanta	13121	0033	4	1082	514	515	0	0	0
71	Atlanta	13121	0035	1	875	315	318	0	0	0
72	Atlanta	13121	0035	2	179	9	9	0	0	0
73	Atlanta	13121	0036	1	593	312	336	0	0	0
74	Atlanta	13121	0036	3	46	23	15	0	0	0
75	Atlanta	13121	0037	1	408	663	662	0	0	0
76	Atlanta	13121	0038	1	374	91	95	0	0	0
77	Atlanta	13121	0038	2	375	205	198	0	0	0
	Atlanta	13121	0038	3	324	93	103	0	0	0
[illegible]	Atlanta	13121	0038	4	419	63	53	0	0	0
80	Atlanta	13121	0038	5	1204	325	310	0	0	0
81	Atlanta	13121	0039	1	537	257	232	0	0	0
82	Atlanta	13121	0039	2	373	184	190	0	0	0
83	Atlanta	13121	0039	3	881	498	561	0	0	0
84	Atlanta	13121	0039	4	577	219	200	0	0	0
85	Atlanta	13121	0040	1	633	288	248	0	0	0
86	Atlanta	13121	0040	2	735	320	335	0	0	0
87	Atlanta	13121	0040	3	714	314	336	0	0	0
88	Atlanta	13121	0041	1	623	255	239	0	0	0
89	Atlanta	13121	0041	2	888	384	329	0	0	0
90	Atlanta	13121	0041	3	429	176	178	0	0	0
91	Atlanta	13121	0041	4	538	248	252	0	0	0
92	Atlanta	13121	0043	1	599	282	276	0	0	0
93	Atlanta	13121	0043	2	1623	164	174	0	0	0
94	Atlanta	13121	0043	3	1210	13	7	0	0	0
95	Atlanta	13121	0044	1	532	271	249	0	0	0
96	Atlanta	13121	0044	2	782	255	277	0	0	0
97	Atlanta	13121	0044	3	489	206	212	0	0	0
98	Atlanta	13121	0044	4	42	26	31	0	0	0
99	Atlanta	13121	0044	5	214	128	119	0	0	0
100	Atlanta	13121	0048	1	1930	738	752	0	0	0
101	Atlanta	13121	0048	2	28	16	12	0	0	0
102	Atlanta	13121	0050	1	142	72	83	0	0	0
103	Atlanta	13121	0050	2	1130	555	551	0	0	0
104	Atlanta	13121	0050	3	415	218	208	0	0	0
105	Atlanta	13121	0052	1	996	387	393	0	0	0

106	Atlanta	13121	0052	2	530	227	223	0	0	0
107	Atlanta	13121	0052	3	518	270	277	0	0	0
108	Atlanta	13121	0052	4	573	239	229	0	0	0
109	Atlanta	13121	0052	5	1093	464	465	0	0	0
110	Atlanta	13121	0053	1	781	353	354	0	0	0
111	Atlanta	13121	0053	2	491	199	209	0	0	0
112	Atlanta	13121	0053	3	822	325	323	0	0	0
113	Atlanta	13121	0053	4	506	218	214	0	0	0
114	Atlanta	13121	0053	5	473	201	196	0	0	0
115	Atlanta	13121	0056	1	131	87	122	0	0	0
116	Atlanta	13121	0056	2	498	255	257	0	0	0
117	Atlanta	13121	0056	3	248	131	127	0	0	0
118	Atlanta	13121	0056	4	251	50	58	0	0	0
119	Atlanta	13121	0056	5	253	111	121	0	0	0
120	Atlanta	13121	0056	6	236	116	110	0	0	0
121	Atlanta	13121	0057	1	622	250	240	0	0	0
122	Atlanta	13121	0057	2	578	246	240	0	0	0
123	Atlanta	13121	0057	3	224	122	131	0	0	0
124	Atlanta	13121	0058	1	219	83	82	0	0	0
125	Atlanta	13121	0058	2	1453	613	576	0	0	0
126	Atlanta	13121	0060	1	793	283	274	0	0	0
127	Atlanta	13121	0060	2	1141	412	387	0	0	0
128	Atlanta	13121	0060	3	1233	467	485	0	0	0
129	Atlanta	13121	0060	4	1141	544	560	0	0	0
130	Atlanta	13121	0061	1	808	292	272	0	0	0
131	Atlanta	13121	0061	2	1658	596	600	0	0	0
[illegible]	Atlanta	13121	0061	3	1140	446	439	0	0	0
133	Atlanta	13121	0061	4	365	130	160	0	0	0
134	Atlanta	13121	0061	5	646	205	198	0	0	0
135	Atlanta	13121	0062	1	406	145	141	0	0	0
136	Atlanta	13121	0062	2	684	266	253	0	0	0
137	Atlanta	13121	0062	3	673	266	280	0	0	0
138	Atlanta	13121	0063	1	290	176	172	0	0	0
139	Atlanta	13121	0063	2	429	261	273	0	0	0
140	Atlanta	13121	0063	3	847	396	385	0	0	0
141	Atlanta	13121	0063	4	577	319	325	0	0	0
142	Atlanta	13121	0064	1	2924	896	896	0	0	0
143	Atlanta	13121	0065	1	1015	348	329	0	0	0
144	Atlanta	13121	0065	2	563	219	207	0	0	0
145	Atlanta	13121	0065	3	1230	443	469	0	0	0
146	Atlanta	13121	0065	4	588	242	244	0	0	0
147	Atlanta	13121	0065	5	607	261	272	0	0	0
148	Atlanta	13121	0065	6	717	319	311	0	0	0
149	Atlanta	13121	0067	1	310	130	116	0	0	0
150	Atlanta	13121	0067	2	157	81	62	0	0	0
151	Atlanta	13121	0067	3	412	170	152	0	0	0
152	Atlanta	13121	0067	4	168	75	84	0	0	0
153	Atlanta	13121	0067	5	397	176	168	0	0	0
154	Atlanta	13121	0067	6	1005	474	439	0	0	0
155	Atlanta	13121	0067	7	1797	895	954	0	0	0
156	Atlanta	13121	0069	1	756	289	281	0	0	0
157	Atlanta	13121	0069	2	1659	604	618	0	0	0
158	Atlanta	13121	0069	3	1159	483	477	0	0	0
159	Atlanta	13121	0070	1	764	262	285	0	0	0

160	Atlanta	13121	0070	2	909	330	318	0	0	0
161	Atlanta	13121	0070	3	1796	523	493	0	0	0
162	Atlanta	13121	0070	4	1585	524	512	0	0	0
163	Atlanta	13121	0070	5	1081	344	296	6	0	0
164	Atlanta	13121	0070	6	2312	846	932	0	0	0
165	Atlanta	13121	0070	7	649	261	248	0	0	0
166	Atlanta	13121	0071	1	2197	639	613	0	0	0
167	Atlanta	13121	0071	2	553	180	197	0	0	0
168	Atlanta	13121	0071	3	1692	547	556	0	0	0
169	Atlanta	13121	0072	1	464	139	121	0	0	0
170	Atlanta	13121	0072	2	1885	858	901	0	0	0
171	Atlanta	13121	0072	3	1	1	0	0	0	0
172	Atlanta	13121	0072	4	85	24	25	0	0	0
173	Atlanta	13121	0072	5	1419	425	400	0	0	0
174	Atlanta	13121	0073	1	2783	942	955	0	0	0
175	Atlanta	13121	0073	2	1746	595	603	0	0	0
176	Atlanta	13121	0073	3	2193	838	817	0	0	0
177	Atlanta	13121	0074	1	2007	832	799	0	0	0
178	Atlanta	13121	0074	2	1195	376	409	0	0	0
179	Atlanta	13121	0075	1	487	245	229	0	0	0
180	Atlanta	13121	0075	2	822	451	450	0	0	0
181	Atlanta	13121	0075	3	872	482	460	0	0	0
182	Atlanta	13121	0075	4	708	416	507	0	0	0
183	Atlanta	13121	0075	5	761	337	338	0	0	0
184	Atlanta	13121	0080	1	1400	469	438	0	0	0
185	Atlanta	13121	0080	2	1218	400	396	0	0	0
[illegible]	Atlanta	13121	0080	3	792	257	266	0	0	0
[illegible]	Atlanta	13121	0080	4	702	265	261	0	0	0
188	Atlanta	13121	0080	6	1644	580	619	0	0	0
189	College Park	13121	0107	1	970	431	443	0	16	0
190	Atlanta	13121	0108	1	814	365	363	0	0	0
191	Atlanta	13121	0108	2	1005	495	474	0	0	0
192	Atlanta	13121	0108	3	649	280	272	0	0	0
193	Atlanta	13121	0108	4	1044	442	442	0	0	0
194	Atlanta	13121	0108	5	333	203	202	0	0	0
195	Atlanta	13121	0108	6	152	133	135	0	0	0
196	Atlanta	13121	0108	7	750	395	403	0	0	0
197	Atlanta	13121	0108	8	736	357	379	0	0	0
198	East Point	13121	0109	1	274	134	115	0	0	0
199	East Point	13121	0109	2	427	166	185	0	0	0
200	East Point	13121	0109	3	11	5	6	0	0	0
201	East Point	13121	0110	1	897	418	449	0	0	0
202	East Point	13121	0110	2	1212	401	402	0	0	0
203	East Point	13121	0110	3	332	133	106	0	0	0
204	East Point	13121	0110	4	416	141	136	0	0	0
205	East Point	13121	0110	5	736	346	340	0	0	0
206	East Point	13121	0110	6	380	132	147	0	0	0
207	East Point	13121	0111	1	822	375	363	0	0	0
208	East Point	13121	0111	2	720	312	302	0	0	0
209	East Point	13121	0111	3	751	346	359	0	0	0
210	East Point	13121	0111	4	418	211	220	0	0	0
211	Atlanta	13121	0042951		1325	479	524	0	0	0
212	Atlanta	13121	0042952		313	266	296	0	0	0
213	Atlanta	13121	0042953		0	0	0	0	0	0

214	Atlanta	13121 0042954	98	49	41	0	0	0
215	Atlanta	13121 0042955	739	396	394	0	0	0
216	Atlanta	13121 0046951	0	0	0	0	0	0
217	Atlanta	13121 0046952	121	46	45	0	0	0
218	Atlanta	13121 0046953	170	83	83	0	0	0
219	Atlanta	13121 0046954	233	156	162	0	0	0
220	Atlanta	13121 0046955	217	82	75	0	0	0
221	Atlanta	13121 0046956	488	210	200	0	0	0
222	Atlanta	13121 0046957	35	31	33	0	0	0
223	Atlanta	13121 0049951	297	60	76	0	0	0
224	Atlanta	13121 0049952	150	96	106	0	0	0
225	Atlanta	13121 0049953	460	205	201	0	0	0
226	Atlanta	13121 0049954	294	168	195	0	0	0
227	Atlanta	13121 0049955	401	174	159	0	0	0
228	Atlanta	13121 0049956	428	224	193	0	0	0
229	Atlanta	13121 0055011	191	102	99	0	0	0
230	Atlanta	13121 0055012	199	168	172	0	0	0
231	Atlanta	13121 0055013	695	293	305	0	0	0
232	Atlanta	13121 0055014	1087	477	459	0	0	0
233	Atlanta	13121 0055015	481	219	208	0	0	0
234	Atlanta	13121 0055021	887	368	383	0	0	0
235	Atlanta	13121 0055022	2679	995	989	0	0	7
236	Atlanta	13121 0066011	285	122	121	0	0	0
237	Atlanta	13121 0066012	677	283	272	0	0	0
238	Atlanta	13121 0066013	400	177	186	0	0	0
239	Atlanta	13121 0066014	362	156	178	0	0	0
[illegible]	Atlanta	13121 0066015	602	222	216	0	0	0
[illegible]	Atlanta	13121 0066021	518	221	228	0	0	0
242	Atlanta	13121 0066022	908	348	328	0	0	0
243	Atlanta	13121 0068011	1387	19	14	0	0	9
244	Atlanta	13121 0068021	2015	554	576	0	0	0
245	Atlanta	13121 0076011	2801	1457	1475	0	0	0
246	Atlanta	13121 0076012	3976	2069	2087	0	0	0
247	Atlanta	13121 0076019	643	116	80	0	0	0
248	Atlanta	13121 0076021	745	289	307	0	0	0
249	Atlanta	13121 0076022	947	367	346	0	0	0
250	Atlanta	13121 0081011	438	157	157	0	0	0
251	Atlanta	13121 0081012	458	169	178	0	0	0
252	East Point	13121 0112011	1741	848	888	0	0	0
253	East Point	13121 0112012	1077	465	431	0	0	0
254	East Point	13121 0112013	451	251	245	0	0	0
255	East Point	13121 0112014	2101	901	901	0	0	0
256	East Point	13121 0112021	283	159	166	0	0	0
257	East Point	13121 0112022	86	28	18	0	0	6
258	East Point	13121 0112023	498	204	222	0	0	0
259	East Point	13121 0112026	612	315	308	0	0	0
260	East Point	13121 0112027	698	371	370	0	0	0
261	East Point	13121 0112028	675	345	331	0	0	0
---	----------------	------------	------	------	------	------	------	
	Totals:		198463	81713	81758	18	16	29

City	Census Tract ID	Tract People	House Count	Public Water	Drilled Wells	Dug Wells	Other Wells
Atlanta	13121 0061 2	1658	596	600	0	0	0
Atlanta	13121 0061 3	1140	446	439	0	0	0
Atlanta	13121 0061 4	365	130	160	0	0	0
Atlanta	13121 0061 5	646	205	198	0	0	0
Atlanta	13121 0062 1	406	145	141	0	0	0
Atlanta	13121 0062 2	684	266	253	0	0	0
Atlanta	13121 0062 3	673	266	280	0	0	0
Atlanta	13121 0063 1	290	176	172	0	0	0
Atlanta	13121 0063 2	429	261	273	0	0	0
Atlanta	13121 0063 3	847	396	385	0	0	0
Atlanta	13121 0063 4	577	319	325	0	0	0
Atlanta	13121 0064 1	2924	896	896	0	0	0
Atlanta	13121 0065 1	1015	348	329	0	0	0
Atlanta	13121 0065 2	563	219	207	0	0	0
Atlanta	13121 0065 3	1230	443	469	0	0	0
Atlanta	13121 0065 4	588	242	244	0	0	0
Atlanta	13121 0065 5	607	261	272	0	0	0
Atlanta	13121 0065 6	717	319	311	0	0	0
Atlanta	13121 0067 1	310	130	116	0	0	0
Atlanta	13121 0017 2	431	308	298	0	0	0
Atlanta	13121 0017 3	413	89	90	0	0	0
Atlanta	13121 0018 4	692	479	518	0	0	0
Atlanta	13121 0018 5	453	366	371	0	0	0
Atlanta	13121 0018 6	30	24	16	0	0	0
Atlanta	13121 0019 1	404	79	74	0	0	0
Atlanta	13121 0019 2	211	314	318	0	0	0
Atlanta	13121 0021 2	232	7	3	0	0	0
Atlanta	13121 0021 3	2	2	0	0	0	0
Atlanta	13121 0022 3	38	31	29	0	0	0
Atlanta	13121 0022 4	531	255	263	0	0	0
Atlanta	13121 0024 1	510	242	225	0	0	0
Atlanta	13121 0024 2	668	384	365	0	0	0
Atlanta	13121 0024 3	197	136	137	0	0	0
Atlanta	13121 0024 4	473	235	207	0	0	0
Atlanta	13121 0024 5	655	499	504	0	0	0
Atlanta	13121 0025 1	322	262	282	0	0	0
Atlanta	13121 0025 2	874	106	100	0	0	0
Atlanta	13121 0025 3	420	228	191	0	0	0
Atlanta	13121 0025 4	130	75	69	0	0	0
Atlanta	13121 0025 5	1064	558	569	0	0	0
Atlanta	13121 0025 6	1052	471	473	0	0	0
Atlanta	13121 0026 1	272	137	139	0	0	7
Atlanta	13121 0026 2	62	85	90	0	0	0
Atlanta	13121 0026 3	0	0	0	0	0	0
Atlanta	13121 0026 4	123	63	56	0	0	0
Atlanta	13121 0026 5	186	97	95	0	0	0
Atlanta	13121 0026 6	250	162	174	0	0	0
Atlanta	13121 0027 1	114	0	0	0	0	0
Atlanta	13121 0027 2	48	11	10	0	0	0

Atlanta	13121	0028	1	645	480	522	0	0	0
Atlanta	13121	0028	2	0	0	0	0	0	0
Atlanta	13121	0028	3	290	181	176	0	0	0
Atlanta	13121	0028	4	975	578	583	0	0	0
Atlanta	13121	0029	1	381	212	201	0	0	0
Atlanta	13121	0029	2	348	242	246	0	0	0
Atlanta	13121	0029	3	415	207	204	0	0	0
Atlanta	13121	0029	4	120	117	121	0	0	0
Atlanta	13121	0030	1	576	330	308	0	0	0
Atlanta	13121	0030	2	341	177	170	0	0	0
Atlanta	13121	0030	3	746	421	414	0	0	0
Atlanta	13121	0031	1	811	377	391	0	0	0
Atlanta	13121	0031	2	410	185	179	0	0	0
Atlanta	13121	0031	3	543	222	220	0	0	0
Atlanta	13121	0032	1	440	233	236	0	0	0
Atlanta	13121	0032	2	409	184	177	0	0	0
Atlanta	13121	0032	3	392	250	241	0	0	0
Atlanta	13121	0033	1	342	201	228	0	0	0
Atlanta	13121	0033	2	277	161	166	0	0	0
Atlanta	13121	0033	3	657	447	421	0	0	0
Atlanta	13121	0033	4	1082	514	515	0	0	0
Atlanta	13121	0035	1	875	315	318	0	0	0
Atlanta	13121	0035	2	179	9	9	0	0	0
Atlanta	13121	0036	1	593	312	336	0	0	0
Atlanta	13121	0036	3	46	23	15	0	0	0
Atlanta	13121	0037	1	408	663	662	0	0	0
Atlanta	13121	0038	1	374	91	95	0	0	0
Atlanta	13121	0038	2	375	205	198	0	0	0
Atlanta	13121	0038	3	324	93	103	0	0	0
Atlanta	13121	0038	4	419	63	53	0	0	0
Atlanta	13121	0038	5	1204	325	310	0	0	0
Atlanta	13121	0039	1	537	257	232	0	0	0
Atlanta	13121	0039	2	373	184	190	0	0	0
Atlanta	13121	0039	3	881	498	561	0	0	0
Atlanta	13121	0039	4	577	219	200	0	0	0
Atlanta	13121	0040	1	633	288	248	0	0	0
Atlanta	13121	0040	2	735	320	335	0	0	0
Atlanta	13121	0040	3	714	314	336	0	0	0
Atlanta	13121	0041	1	623	255	239	0	0	0
Atlanta	13121	0041	2	888	384	329	0	0	0
Atlanta	13121	0041	3	429	176	178	0	0	0
Atlanta	13121	0041	4	538	248	252	0	0	0
Atlanta	13121	0043	1	599	282	276	0	0	0
Atlanta	13121	0043	2	1623	164	174	0	0	0
Atlanta	13121	0043	3	1210	13	7	0	0	0
Atlanta	13121	0044	1	532	271	249	0	0	0
Atlanta	13121	0044	2	782	255	277	0	0	0
Atlanta	13121	0044	3	489	206	212	0	0	0
Atlanta	13121	0044	4	42	26	31	0	0	0
Atlanta	13121	0044	5	214	128	119	0	0	0
Atlanta	13121	0048	1	1930	738	752	0	0	0
Atlanta	13121	0048	2	28	16	12	0	0	0
Atlanta	13121	0050	1	142	72	83	0	0	0
Atlanta	13121	0050	2	1130	555	551	0	0	0

Atlanta	13121	0050	3	415	218	208	0	0	0
Atlanta	13121	0052	1	996	387	393	0	0	0
Atlanta	13121	0052	2	530	227	223	0	0	0
Atlanta	13121	0052	3	518	270	277	0	0	0
Atlanta	13121	0052	4	573	239	229	0	0	0
Atlanta	13121	0052	5	1093	464	465	0	0	0
Atlanta	13121	0053	1	781	353	354	0	0	0
Atlanta	13121	0053	2	491	199	209	0	0	0
Atlanta	13121	0053	3	822	325	323	0	0	0
Atlanta	13121	0053	4	506	218	214	0	0	0
Atlanta	13121	0053	5	473	201	196	0	0	0
Atlanta	13121	0056	1	131	87	122	0	0	0
Atlanta	13121	0056	2	498	255	257	0	0	0
Atlanta	13121	0056	3	248	131	127	0	0	0
Atlanta	13121	0056	4	251	50	58	0	0	0
Atlanta	13121	0056	5	253	111	121	0	0	0
Atlanta	13121	0056	6	236	116	110	0	0	0
Atlanta	13121	0057	1	622	250	240	0	0	0
Atlanta	13121	0057	2	578	246	240	0	0	0
Atlanta	13121	0057	3	224	122	131	0	0	0
Atlanta	13121	0058	1	219	83	82	0	0	0
Atlanta	13121	0058	2	1453	613	576	0	0	0
Atlanta	13121	0060	1	793	283	274	0	0	0
Atlanta	13121	0060	2	1141	412	387	0	0	0
Atlanta	13121	0060	3	1233	467	485	0	0	0
Atlanta	13121	0060	4	1141	544	560	0	0	0
A nta	13121	0061	1	808	292	272	0	0	0
At,anta	13121	0108	7	750	395	403	0	0	0
Atlanta	13121	0108	8	736	357	379	0	0	0
Atlanta	13121	0070	7	649	261	248	0	0	0
Atlanta	13121	0071	1	2197	639	613	0	0	0
Atlanta	13121	0071	2	553	180	197	0	0	0
Atlanta	13121	0071	3	1692	547	556	0	0	0
Atlanta	13121	0072	1	464	139	121	0	0	0
Atlanta	13121	0072	2	1885	858	901	0	0	0
Atlanta	13121	0072	3	1	1	0	0	0	0
Atlanta	13121	0072	4	85	24	25	0	0	0
Atlanta	13121	0072	5	1419	425	400	0	0	0
Atlanta	13121	0073	1	2783	942	955	0	0	0
Atlanta	13121	0073	2	1746	595	603	0	0	0
Atlanta	13121	0073	3	2193	838	817	0	0	0
Atlanta	13121	0074	1	2007	832	799	0	0	0
Atlanta	13121	0042951		1325	479	524	0	0	0
Atlanta	13121	0042952		313	266	296	0	0	0
Atlanta	13121	0042953		0	0	0	0	0	0
Atlanta	13121	0042954		98	49	41	0	0	0
Atlanta	13121	0067	2	157	81	62	0	0	0
Atlanta	13121	0067	3	412	170	152	0	0	0
Atlanta	13121	0067	4	168	75	84	0	0	0
Atlanta	13121	0067	5	397	176	168	0	0	0
Atlanta	13121	0067	6	1005	474	439	0	0	0
Atlanta	13121	0067	7	1797	895	954	0	0	0
Atlanta	13121	0069	1	756	289	281	0	0	0
Atlanta	13121	0069	2	1659	604	618	0	0	0

Atlanta	13121	0069 3	1159	483	477	0	0	0
Atlanta	13121	0070 1	764	262	285	0	0	0
Atlanta	13121	0070 2	909	330	318	0	0	0
Atlanta	13121	0070 3	1796	523	493	0	0	0
Atlanta	13121	0070 4	1585	524	512	0	0	0
Atlanta	13121	0070 5	1081	344	296	6	0	0
Atlanta	13121	0070 6	2312	846	932	0	0	0
Atlanta	13121	0055011	191	102	99	0	0	0
Atlanta	13121	0055012	199	168	172	0	0	0
Atlanta	13121	0055013	695	293	305	0	0	0
Atlanta	13121	0055014	1087	477	459	0	0	0
Atlanta	13121	0055015	481	219	208	0	0	0
Atlanta	13121	0055021	887	368	383	0	0	0
Atlanta	13121	0055022	2679	995	989	0	0	7
Atlanta	13121	0066011	285	122	121	0	0	0
Atlanta	13121	0066012	677	283	272	0	0	0
Atlanta	13121	0066013	400	177	186	0	0	0
Atlanta	13121	0066014	362	156	178	0	0	0
Atlanta	13121	0066015	602	222	216	0	0	0
Atlanta	13121	0066021	518	221	228	0	0	0
Atlanta	13121	0074 2	1195	376	409	0	0	0
Atlanta	13121	0075 1	487	245	229	0	0	0
Atlanta	13121	0075 2	822	451	450	0	0	0
Atlanta	13121	0075 3	872	482	460	0	0	0
Atlanta	13121	0075 4	708	416	507	0	0	0
Atlanta	13121	0075 5	761	337	338	0	0	0
Atlanta	13121	0080 1	1400	469	438	0	0	0
Atlanta	13121	0080 2	1218	400	396	0	0	0
Atlanta	13121	0080 3	792	257	266	0	0	0
Atlanta	13121	0080 4	702	265	261	0	0	0
Atlanta	13121	0080 6	1644	580	619	0	0	0
Atlanta	13121	0046956	488	210	200	0	0	0
Atlanta	13121	0108 1	814	365	363	0	0	0
Atlanta	13121	0108 2	1005	495	474	0	0	0
Atlanta	13121	0108 3	649	280	272	0	0	0
Atlanta	13121	0108 4	1044	442	442	0	0	0
Atlanta	13121	0108 5	333	203	202	0	0	0
Atlanta	13121	0108 6	152	133	135	0	0	0
Atlanta	13121	0049956	428	224	193	0	0	0
Atlanta	13121	0076011	2801	1457	1475	0	0	0
Atlanta	13121	0076012	3976	2069	2087	0	0	0
Atlanta	13121	0042955	739	396	394	0	0	0
Atlanta	13121	0046951	0	0	0	0	0	0
Atlanta	13121	0046952	121	46	45	0	0	0
Atlanta	13121	0046953	170	83	83	0	0	0
Atlanta	13121	0046954	233	156	162	0	0	0
Atlanta	13121	0046955	217	82	75	0	0	0
Atlanta	13121	0049953	460	205	201	0	0	0
Atlanta	13121	0046957	35	31	33	0	0	0
Atlanta	13121	0049951	297	60	76	0	0	0
Atlanta	13121	0049952	150	96	106	0	0	0
Atlanta	13121	0076022	947	367	346	0	0	0
Atlanta	13121	0066022	908	348	328	0	0	0
Atlanta	13121	0068011	1387	19	14	0	0	9

Atlanta	13121	0068021	2015	554	576	0	0	0
Atlanta	13121	0076019	643	116	80	0	0	0
Atlanta	13121	0081011	438	157	157	0	0	0
Atlanta	13121	0081012	458	169	178	0	0	0
Atlanta	13121	0076021	745	289	307	0	0	0
Atlanta	13121	0049955	401	174	159	0	0	0
Atlanta	13121	0049954	294	168	195	0	0	0
	Sub Totals:		153064	63997	64026	6	0	23
Atlanta-Decatur	13089	0238011	814	269	267	0	0	0
Atlanta-Decatur	13089	0234044	58	31	15	12	0	0
Atlanta-Decatur	13089	0209 1	2187	915	932	0	0	0
Atlanta-Decatur	13089	0209 2	1714	677	652	0	0	0
Atlanta-Decatur	13089	0205 2	1014	515	500	0	0	0
Atlanta-Decatur	13089	0238021	785	183	198	0	0	0
Atlanta-Decatur	13089	0238022	948	64	61	0	0	0
Atlanta-Decatur	13089	0238012	1653	585	551	0	0	0
Atlanta-Decatur	13089	0238013	2425	923	957	0	0	0
Atlanta-Decatur	13089	0205 1	2419	1012	1027	0	0	0
Atlanta-Decatur	13089	0238033	2373	733	732	0	0	0
Atlanta-Decatur	13089	0238034	1686	512	478	0	0	0
Atlanta-Decatur	13089	0209 3	2069	624	644	0	0	0
Atlanta-Decatur	13089	0209 4	1379	550	541	0	0	0
Atlanta-Decatur	13089	0237 4	2381	859	897	0	0	0
Atlanta-Decatur	13089	0237 5	429	156	132	0	0	0
Atlanta-Decatur	13089	0234043	837	305	290	0	0	0
Atlanta-Decatur	13089	0238032	1004	311	284	0	0	0
Atlanta-Decatur	13089	0238023	2636	1054	1121	0	0	0
	Sub Totals:		28811	10278	10279	12	0	0
College Park	13121	0107 1	970	431	443	0	16	0
	Sub Totals:		970	431	443	0	16	0
East Point	13121	0110 6	380	132	147	0	0	0
East Point	13121	0111 2	720	312	302	0	0	0
East Point	13121	0111 3	751	346	359	0	0	0
East Point	13121	0111 4	418	211	220	0	0	0
East Point	13121	0111 1	822	375	363	0	0	0
East Point	13121	0110 4	416	141	136	0	0	0
East Point	13121	0110 5	736	346	340	0	0	0
East Point	13121	0109 1	274	134	115	0	0	0
East Point	13121	0109 2	427	166	185	0	0	0
East Point	13121	0109 3	11	5	6	0	0	0
East Point	13121	0110 1	897	418	449	0	0	0
East Point	13121	0110 2	1212	401	402	0	0	0
East Point	13121	0110 3	332	133	106	0	0	0
East Point	13121	0112011	1741	848	888	0	0	0
East Point	13121	0112012	1077	465	431	0	0	0
East Point	13121	0112013	451	251	245	0	0	0
East Point	13121	0112014	2101	901	901	0	0	0
East Point	13121	0112021	283	159	166	0	0	0

East Point	13121 0112022	86	28	18	0	0	6
East Point	13121 0112023	498	204	222	0	0	0
East Point	13121 0112026	612	315	308	0	0	0
East Point	13121 0112027	698	371	370	0	0	0
East Point	13121 0112028	675	345	331	0	0	0
	Sub Totals:	15618	7007	7010	0	0	6

For Radius of 4 Mi., Circle Area = 50.265482

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
1	Atlanta-Decatur	13089 2051	0.404054	0.162227	40.15
2	Atlanta-Decatur	13089 2052	0.233886	0.048592	20.78
3	Atlanta-Decatur	13089 2091	0.621391	0.477207	76.80
4	Atlanta-Decatur	13089 2092	0.365893	0.365893	100.00
5	Atlanta-Decatur	13089 2093	0.354188	0.354188	100.00
6	Atlanta-Decatur	13089 2094	0.377978	0.377978	100.00
7	Atlanta-Decatur	13089 2374	0.733344	0.079078	10.78
8	Atlanta-Decatur	13089 2375	0.171422	0.149310	87.10
9	Atlanta-Decatur	13089 234043	2.650683	0.144501	5.45
10	Atlanta-Decatur	13089 234044	2.470104	1.143769	46.30
11	Atlanta-Decatur	13089 238011	0.122757	0.122757	100.00
12	Atlanta-Decatur	13089 238012	0.553384	0.553384	100.00
13	Atlanta-Decatur	13089 238013	0.811910	0.811910	100.00
14	Atlanta-Decatur	13089 238021	1.117667	1.117667	100.00
15	Atlanta-Decatur	13089 238022	1.829028	1.805394	98.71
16	Atlanta-Decatur	13089 238023	0.888784	0.564045	63.46
17	Atlanta-Decatur	13089 238032	0.267572	0.077524	28.97
18	Atlanta-Decatur	13089 238033	0.675805	0.263029	38.92
19	Atlanta-Decatur	13089 238034	0.500517	0.276180	55.18
20	Atlanta	13121 172	0.124559	0.022457	18.03
21	Atlanta	13121 173	0.054870	0.040697	74.17
	Atlanta	13121 184	0.101558	0.012502	12.31
23	Atlanta	13121 185	0.039490	0.038985	98.72
24	Atlanta	13121 186	0.049891	0.049891	100.00
25	Atlanta	13121 191	0.189205	0.001662	0.88
26	Atlanta	13121 192	0.154572	0.127830	82.70
27	Atlanta	13121 212	0.055367	0.031887	57.59
28	Atlanta	13121 213	0.096087	0.096087	100.00
29	Atlanta	13121 223	0.041072	0.006020	14.66
30	Atlanta	13121 224	0.028145	0.000011	0.04
31	Atlanta	13121 241	0.081716	0.001499	1.83
32	Atlanta	13121 242	0.142485	0.050866	35.70
33	Atlanta	13121 243	0.037931	0.028782	75.88
34	Atlanta	13121 244	0.088603	0.000009	0.01
35	Atlanta	13121 245	0.183160	0.006843	3.74
36	Atlanta	13121 251	0.035574	0.021393	60.14
37	Atlanta	13121 252	0.039442	0.039442	100.00
38	Atlanta	13121 253	0.065849	0.059403	90.21
39	Atlanta	13121 254	0.028062	0.010259	36.56
40	Atlanta	13121 255	0.083511	0.021349	25.56
41	Atlanta	13121 256	0.076081	0.075799	99.63
42	Atlanta	13121 261	0.074468	0.060792	81.64
43	Atlanta	13121 262	0.057869	0.057869	100.00
44	Atlanta	13121 263	0.087400	0.087400	100.00
45	Atlanta	13121 264	0.046256	0.046256	100.00
46	Atlanta	13121 265	0.047068	0.047068	100.00
47	Atlanta	13121 266	0.039995	0.039995	100.00
48	Atlanta	13121 271	0.194850	0.194850	100.00
49	Atlanta	13121 272	0.117368	0.117368	100.00

50	Atlanta	13121	281	0.155886	0.155886	100.00
51	Atlanta	13121	282	0.005838	0.005838	100.00
52	Atlanta	13121	283	0.062757	0.062757	100.00
53	Atlanta	13121	284	0.068197	0.068197	100.00
54	Atlanta	13121	291	0.083816	0.083696	99.86
55	Atlanta	13121	292	0.068778	0.068778	100.00
56	Atlanta	13121	293	0.085658	0.085658	100.00
57	Atlanta	13121	294	0.032695	0.032695	100.00
58	Atlanta	13121	301	0.178738	0.004180	2.34
59	Atlanta	13121	302	0.131080	0.119397	91.09
60	Atlanta	13121	303	0.166176	0.142630	85.83
61	Atlanta	13121	311	0.129659	0.104828	80.85
62	Atlanta	13121	312	0.078415	0.078415	100.00
63	Atlanta	13121	313	0.105283	0.105283	100.00
64	Atlanta	13121	321	0.170255	0.170255	100.00
65	Atlanta	13121	322	0.079101	0.079101	100.00
66	Atlanta	13121	323	0.161399	0.161399	100.00
67	Atlanta	13121	331	0.046694	0.046694	100.00
68	Atlanta	13121	332	0.030316	0.030316	100.00
69	Atlanta	13121	333	0.063566	0.063566	100.00
70	Atlanta	13121	334	0.125366	0.125366	100.00
71	Atlanta	13121	351	0.273865	0.273865	100.00
72	Atlanta	13121	352	0.297707	0.297707	100.00
73	Atlanta	13121	361	0.104735	0.104735	100.00
74	Atlanta	13121	363	0.043562	0.043562	100.00
75	Atlanta	13121	371	0.034785	0.034785	100.00
	Atlanta	13121	381	0.080676	0.080676	100.00
[illegible]	Atlanta	13121	382	0.040501	0.040501	100.00
78	Atlanta	13121	383	0.087519	0.087519	100.00
79	Atlanta	13121	384	0.028335	0.028335	100.00
80	Atlanta	13121	385	0.077678	0.077678	100.00
81	Atlanta	13121	391	0.139421	0.139421	100.00
82	Atlanta	13121	392	0.044552	0.044552	100.00
83	Atlanta	13121	393	0.103365	0.103365	100.00
84	Atlanta	13121	394	0.031541	0.031541	100.00
85	Atlanta	13121	401	0.112745	0.091314	80.99
86	Atlanta	13121	402	0.204815	0.110943	54.17
87	Atlanta	13121	403	0.116072	0.030957	26.67
88	Atlanta	13121	411	0.128666	0.128666	100.00
89	Atlanta	13121	412	0.112810	0.112810	100.00
90	Atlanta	13121	413	0.107530	0.107530	100.00
91	Atlanta	13121	414	0.125385	0.125385	100.00
92	Atlanta	13121	431	0.083710	0.083710	100.00
93	Atlanta	13121	432	0.115713	0.115713	100.00
94	Atlanta	13121	433	0.042616	0.042616	100.00
95	Atlanta	13121	441	0.138208	0.138208	100.00
96	Atlanta	13121	442	0.042437	0.042437	100.00
97	Atlanta	13121	443	0.061949	0.061949	100.00
98	Atlanta	13121	444	0.038453	0.038453	100.00
99	Atlanta	13121	445	0.058750	0.058750	100.00
100	Atlanta	13121	481	0.131710	0.131710	100.00
101	Atlanta	13121	482	0.014330	0.014330	100.00
102	Atlanta	13121	501	0.119466	0.119466	100.00
103	Atlanta	13121	502	0.339055	0.339055	100.00

104	Atlanta	13121	503	0.064919	0.064919	100.00
105	Atlanta	13121	521	0.245141	0.245141	100.00
106	Atlanta	13121	522	0.139419	0.139419	100.00
107	Atlanta	13121	523	0.153243	0.153243	100.00
108	Atlanta	13121	524	0.096920	0.096920	100.00
109	Atlanta	13121	525	0.238606	0.238606	100.00
110	Atlanta	13121	531	0.151621	0.151621	100.00
111	Atlanta	13121	532	0.110627	0.110627	100.00
112	Atlanta	13121	533	0.208607	0.208607	100.00
113	Atlanta	13121	534	0.082251	0.082251	100.00
114	Atlanta	13121	535	0.293833	0.293833	100.00
115	Atlanta	13121	561	0.063077	0.063077	100.00
116	Atlanta	13121	562	0.064775	0.064775	100.00
117	Atlanta	13121	563	0.076414	0.076414	100.00
118	Atlanta	13121	564	0.074896	0.074896	100.00
119	Atlanta	13121	565	0.058004	0.058004	100.00
120	Atlanta	13121	566	0.047359	0.047359	100.00
121	Atlanta	13121	571	0.142521	0.142521	100.00
122	Atlanta	13121	572	0.063520	0.063520	100.00
123	Atlanta	13121	573	0.049530	0.049530	100.00
124	Atlanta	13121	581	0.258280	0.258280	100.00
125	Atlanta	13121	582	0.232828	0.232828	100.00
126	Atlanta	13121	601	0.086674	0.065567	75.65
127	Atlanta	13121	602	0.172627	0.146411	84.81
128	Atlanta	13121	603	0.156567	0.154511	98.69
129	Atlanta	13121	604	0.166954	0.166954	100.00
[illegible]	Atlanta	13121	611	0.115951	0.115951	100.00
131	Atlanta	13121	612	0.334623	0.334623	100.00
132	Atlanta	13121	613	0.214681	0.214681	100.00
133	Atlanta	13121	614	0.044304	0.044304	100.00
134	Atlanta	13121	615	0.134026	0.134026	100.00
135	Atlanta	13121	621	0.077939	0.077939	100.00
136	Atlanta	13121	622	0.185329	0.185329	100.00
137	Atlanta	13121	623	0.126712	0.126712	100.00
138	Atlanta	13121	631	0.078323	0.078323	100.00
139	Atlanta	13121	632	0.081000	0.081000	100.00
140	Atlanta	13121	633	0.193138	0.193138	100.00
141	Atlanta	13121	634	0.217809	0.217809	100.00
142	Atlanta	13121	641	0.480002	0.480002	100.00
143	Atlanta	13121	651	0.423676	0.423676	100.00
144	Atlanta	13121	652	0.127225	0.127225	100.00
145	Atlanta	13121	653	0.308548	0.308548	100.00
146	Atlanta	13121	654	0.073940	0.073940	100.00
147	Atlanta	13121	655	0.083524	0.083524	100.00
148	Atlanta	13121	656	0.239297	0.239297	100.00
149	Atlanta	13121	671	0.145823	0.145823	100.00
150	Atlanta	13121	672	0.041646	0.041646	100.00
151	East Point	13121	112028	0.130774	0.000356	0.27
152	Atlanta	13121	674	0.051006	0.051006	100.00
153	Atlanta	13121	675	0.399513	0.399513	100.00
154	Atlanta	13121	676	0.254397	0.254397	100.00
155	Atlanta	13121	677	0.296340	0.296340	100.00
156	Atlanta	13121	691	0.326346	0.326346	100.00
157	Atlanta	13121	692	0.293064	0.293064	100.00

158	Atlanta	13121	693	0.577665	0.577665	100.00
159	Atlanta	13121	701	0.528927	0.528927	100.00
160	Atlanta	13121	702	0.323003	0.323003	100.00
161	Atlanta	13121	703	0.365966	0.365966	100.00
162	Atlanta	13121	704	0.709338	0.709338	100.00
163	Atlanta	13121	705	0.260577	0.260577	100.00
164	Atlanta	13121	706	0.775957	0.775957	100.00
165	Atlanta	13121	707	0.251641	0.251641	100.00
166	Atlanta	13121	711	0.360664	0.360664	100.00
167	Atlanta	13121	712	0.097781	0.097781	100.00
168	Atlanta	13121	713	0.539559	0.539559	100.00
169	Atlanta	13121	721	1.130538	1.130538	100.00
170	Atlanta	13121	722	0.732218	0.346630	47.34
171	Atlanta	13121	723	0.329750	0.223500	67.78
172	Atlanta	13121	724	0.684612	0.619919	90.55
173	Atlanta	13121	725	0.361727	0.361727	100.00
174	Atlanta	13121	731	1.781444	1.781444	100.00
175	Atlanta	13121	732	0.929612	0.929612	100.00
176	Atlanta	13121	733	0.455379	0.455379	100.00
177	Atlanta	13121	741	0.500027	0.500027	100.00
178	Atlanta	13121	742	0.370927	0.370927	100.00
179	Atlanta	13121	751	0.571966	0.571966	100.00
180	Atlanta	13121	752	0.152063	0.152063	100.00
181	Atlanta	13121	753	0.261441	0.261441	100.00
182	Atlanta	13121	754	0.151313	0.151313	100.00
183	Atlanta	13121	755	0.192521	0.192521	100.00
[illegible]	Atlanta	13121	801	0.197164	0.197164	100.00
185	Atlanta	13121	802	0.249753	0.249753	100.00
186	Atlanta	13121	803	0.183242	0.183242	100.00
187	Atlanta	13121	804	0.214354	0.062752	29.28
188	Atlanta	13121	806	1.087888	0.209362	19.24
189	College Park	13121	1071	0.226428	0.002278	1.01
190	Atlanta	13121	1081	0.181361	0.181361	100.00
191	Atlanta	13121	1082	0.191484	0.191484	100.00
192	Atlanta	13121	1083	0.270588	0.270588	100.00
193	Atlanta	13121	1084	0.243816	0.243816	100.00
194	Atlanta	13121	1085	0.427126	0.365225	85.51
195	Atlanta	13121	1086	1.212444	0.265843	21.93
196	Atlanta	13121	1087	0.248496	0.248496	100.00
197	Atlanta	13121	1088	0.332582	0.332582	100.00
198	East Point	13121	1091	0.262527	0.216098	82.31
199	East Point	13121	1092	0.230575	0.188674	81.83
200	East Point	13121	1093	0.077888	0.004571	5.87
201	East Point	13121	1101	0.121878	0.121878	100.00
202	East Point	13121	1102	0.502713	0.502713	100.00
203	East Point	13121	1103	0.071532	0.071532	100.00
204	East Point	13121	1104	0.056765	0.056765	100.00
205	East Point	13121	1105	0.179988	0.179988	100.00
206	East Point	13121	1106	0.091998	0.091998	100.00
207	East Point	13121	1111	0.759284	0.759284	100.00
208	East Point	13121	1112	0.177228	0.177228	100.00
209	East Point	13121	1113	0.145339	0.145339	100.00
210	East Point	13121	1114	0.202221	0.202221	100.00
211	Atlanta	13121	42951	0.100165	0.100165	100.00

212	Atlanta	13121 42952	0.048557	0.048557	100.00
213	Atlanta	13121 42953	0.068745	0.068745	100.00
214	Atlanta	13121 42954	0.054907	0.054907	100.00
215	Atlanta	13121 42955	0.191539	0.191539	100.00
216	Atlanta	13121 46951	0.090518	0.090518	100.00
217	Atlanta	13121 46952	0.041745	0.041745	100.00
218	Atlanta	13121 46953	0.034405	0.034405	100.00
219	Atlanta	13121 46954	0.031337	0.031337	100.00
220	Atlanta	13121 46955	0.029762	0.029762	100.00
221	Atlanta	13121 46956	0.115977	0.115977	100.00
222	Atlanta	13121 46957	0.115618	0.115618	100.00
223	Atlanta	13121 49951	0.062139	0.062139	100.00
224	Atlanta	13121 49952	0.021185	0.021185	100.00
225	Atlanta	13121 49953	0.050087	0.050087	100.00
226	Atlanta	13121 49954	0.129785	0.129785	100.00
227	Atlanta	13121 49955	0.059688	0.059688	100.00
228	Atlanta	13121 49956	0.113572	0.113572	100.00
229	Atlanta	13121 55011	0.064447	0.064447	100.00
230	Atlanta	13121 55012	0.053513	0.053513	100.00
231	Atlanta	13121 55013	0.087241	0.087241	100.00
232	Atlanta	13121 55014	0.138325	0.138325	100.00
233	Atlanta	13121 55015	0.115127	0.115127	100.00
234	Atlanta	13121 55021	0.344384	0.344384	100.00
235	Atlanta	13121 55022	0.297994	0.297994	100.00
236	Atlanta	13121 66011	0.276059	0.276059	100.00
237	Atlanta	13121 66012	0.099666	0.099666	100.00
[illegible]	Atlanta	13121 66013	0.117031	0.117031	100.00
239	Atlanta	13121 66014	0.065924	0.065924	100.00
240	Atlanta	13121 66015	0.180469	0.180469	100.00
241	Atlanta	13121 66021	0.085742	0.085742	100.00
242	Atlanta	13121 66022	0.153311	0.153311	100.00
243	Atlanta	13121 68011	0.265862	0.265862	100.00
244	Atlanta	13121 68021	0.291861	0.291861	100.00
245	Atlanta	13121 76011	0.338370	0.332762	98.34
246	Atlanta	13121 76012	0.518389	0.064184	12.38
247	Atlanta	13121 76019	0.760365	0.760365	100.00
248	Atlanta	13121 76021	0.189941	0.189941	100.00
249	Atlanta	13121 76022	0.315412	0.125959	39.93
250	Atlanta	13121 81011	0.081848	0.005204	6.36
251	Atlanta	13121 81012	0.233030	0.009027	3.87
252	East Point	13121 112011	0.303311	0.303311	100.00
253	East Point	13121 112012	0.298089	0.298089	100.00
254	East Point	13121 112013	0.434189	0.434189	100.00
255	East Point	13121 112014	0.443376	0.308564	69.59
256	East Point	13121 112021	0.078894	0.078894	100.00
257	East Point	13121 112022	0.087936	0.087936	100.00
258	East Point	13121 112023	0.098140	0.023116	23.55
259	East Point	13121 112026	0.183750	0.109813	59.76
260	East Point	13121 112027	0.175513	0.041894	23.87
261	Atlanta	13121 673	0.150356	0.150356	100.00
---	------------------	-----------	----------	----------	------
	Totals:		62.334263	50.048069	

For Radius of 3 Mi., Circle Area = 28.274334

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
4	Atlanta-Decatur	13089 2092	0.365893	0.091011	24.87
10	Atlanta-Decatur	13089 234044	2.470104	0.036124	1.46
11	Atlanta-Decatur	13089 238011	0.122757	0.089463	72.88
12	Atlanta-Decatur	13089 238012	0.553384	0.302248	54.62
13	Atlanta-Decatur	13089 238013	0.811910	0.447219	55.08
14	Atlanta-Decatur	13089 238021	1.117667	1.099170	98.35
15	Atlanta-Decatur	13089 238022	1.829028	0.409876	22.41
48	Atlanta	13121 271	0.194850	0.002089	1.07
65	Atlanta	13121 322	0.079101	0.000005	0.01
66	Atlanta	13121 323	0.161399	0.052336	32.43
69	Atlanta	13121 333	0.063566	0.006835	10.75
70	Atlanta	13121 334	0.125366	0.026271	20.96
71	Atlanta	13121 351	0.273865	0.198000	72.30
72	Atlanta	13121 352	0.297707	0.060409	20.29
80	Atlanta	13121 385	0.077678	0.005393	6.94
91	Atlanta	13121 414	0.125385	0.046678	37.23
92	Atlanta	13121 431	0.083710	0.077229	92.26
93	Atlanta	13121 432	0.115713	0.080343	69.43
94	Atlanta	13121 433	0.042616	0.004010	9.41
95	Atlanta	13121 441	0.138208	0.138208	100.00
	Atlanta	13121 442	0.042437	0.042437	100.00
97	Atlanta	13121 443	0.061949	0.061949	100.00
98	Atlanta	13121 444	0.038453	0.038453	100.00
99	Atlanta	13121 445	0.058750	0.058750	100.00
100	Atlanta	13121 481	0.131710	0.131710	100.00
101	Atlanta	13121 482	0.014330	0.014330	100.00
102	Atlanta	13121 501	0.119466	0.076864	64.34
103	Atlanta	13121 502	0.339055	0.336003	99.10
104	Atlanta	13121 503	0.064919	0.064919	100.00
105	Atlanta	13121 521	0.245141	0.043348	17.68
106	Atlanta	13121 522	0.139419	0.116337	83.44
107	Atlanta	13121 523	0.153243	0.153243	100.00
108	Atlanta	13121 524	0.096920	0.096920	100.00
109	Atlanta	13121 525	0.238606	0.238606	100.00
110	Atlanta	13121 531	0.151621	0.151621	100.00
111	Atlanta	13121 532	0.110627	0.110627	100.00
112	Atlanta	13121 533	0.208607	0.208607	100.00
113	Atlanta	13121 534	0.082251	0.082251	100.00
114	Atlanta	13121 535	0.293833	0.293833	100.00
115	Atlanta	13121 561	0.063077	0.063077	100.00
116	Atlanta	13121 562	0.064775	0.064775	100.00
117	Atlanta	13121 563	0.076414	0.076414	100.00
118	Atlanta	13121 564	0.074896	0.074896	100.00
119	Atlanta	13121 565	0.058004	0.058004	100.00
120	Atlanta	13121 566	0.047359	0.047359	100.00
121	Atlanta	13121 571	0.142521	0.142521	100.00
122	Atlanta	13121 572	0.063520	0.063520	100.00
123	Atlanta	13121 573	0.049530	0.049530	100.00

124	Atlanta	13121	581	0.258280	0.258280	100.00
125	Atlanta	13121	582	0.232828	0.232828	100.00
129	Atlanta	13121	604	0.166954	0.017713	10.61
130	Atlanta	13121	611	0.115951	0.037880	32.67
131	Atlanta	13121	612	0.334623	0.195256	58.35
135	Atlanta	13121	621	0.077939	0.077939	100.00
136	Atlanta	13121	622	0.185329	0.185329	100.00
137	Atlanta	13121	623	0.126712	0.126712	100.00
138	Atlanta	13121	631	0.078323	0.078323	100.00
139	Atlanta	13121	632	0.081000	0.081000	100.00
140	Atlanta	13121	633	0.193138	0.193138	100.00
141	Atlanta	13121	634	0.217809	0.217809	100.00
142	Atlanta	13121	641	0.480002	0.480002	100.00
143	Atlanta	13121	651	0.423676	0.423676	100.00
144	Atlanta	13121	652	0.127225	0.127225	100.00
145	Atlanta	13121	653	0.308548	0.308548	100.00
146	Atlanta	13121	654	0.073940	0.073940	100.00
147	Atlanta	13121	655	0.083524	0.083524	100.00
148	Atlanta	13121	656	0.239297	0.239297	100.00
149	Atlanta	13121	671	0.145823	0.145823	100.00
150	Atlanta	13121	672	0.041646	0.041646	100.00
152	Atlanta	13121	674	0.051006	0.051006	100.00
153	Atlanta	13121	675	0.399513	0.399513	100.00
154	Atlanta	13121	676	0.254397	0.254397	100.00
155	Atlanta	13121	677	0.296340	0.296340	100.00
156	Atlanta	13121	691	0.326346	0.326346	100.00
	Atlanta	13121	692	0.293064	0.293064	100.00
158	Atlanta	13121	693	0.577665	0.577665	100.00
159	Atlanta	13121	701	0.528927	0.528927	100.00
160	Atlanta	13121	702	0.323003	0.323003	100.00
161	Atlanta	13121	703	0.365966	0.365966	100.00
162	Atlanta	13121	704	0.709338	0.709338	100.00
163	Atlanta	13121	705	0.260577	0.260577	100.00
164	Atlanta	13121	706	0.775957	0.775957	100.00
165	Atlanta	13121	707	0.251641	0.251641	100.00
166	Atlanta	13121	711	0.360664	0.360664	100.00
167	Atlanta	13121	712	0.097781	0.097781	100.00
168	Atlanta	13121	713	0.539559	0.539559	100.00
169	Atlanta	13121	721	1.130538	0.344224	30.45
172	Atlanta	13121	724	0.684612	0.002871	0.42
173	Atlanta	13121	725	0.361727	0.004905	1.36
174	Atlanta	13121	731	1.781444	1.595708	89.57
175	Atlanta	13121	732	0.929612	0.612190	65.85
176	Atlanta	13121	733	0.455379	0.455379	100.00
177	Atlanta	13121	741	0.500027	0.500027	100.00
178	Atlanta	13121	742	0.370927	0.370927	100.00
179	Atlanta	13121	751	0.571966	0.571966	100.00
180	Atlanta	13121	752	0.152063	0.152063	100.00
181	Atlanta	13121	753	0.261441	0.261441	100.00
182	Atlanta	13121	754	0.151313	0.151313	100.00
183	Atlanta	13121	755	0.192521	0.192521	100.00
184	Atlanta	13121	801	0.197164	0.140769	71.40
190	Atlanta	13121	1081	0.181361	0.181361	100.00
191	Atlanta	13121	1082	0.191484	0.076390	39.89

192	Atlanta	13121	1083	0.270588	0.069863	25.82
197	Atlanta	13121	1088	0.332582	0.138093	41.52
201	East Point	13121	1101	0.121878	0.121878	100.00
202	East Point	13121	1102	0.502713	0.141157	28.08
207	East Point	13121	1111	0.759284	0.679559	89.50
208	East Point	13121	1112	0.177228	0.177228	100.00
209	East Point	13121	1113	0.145339	0.105829	72.82
211	Atlanta	13121	42951	0.100165	0.025706	25.66
212	Atlanta	13121	42952	0.048557	0.006171	12.71
213	Atlanta	13121	42953	0.068745	0.068745	100.00
214	Atlanta	13121	42954	0.054907	0.039824	72.53
215	Atlanta	13121	42955	0.191539	0.191346	99.90
216	Atlanta	13121	46951	0.090518	0.090518	100.00
217	Atlanta	13121	46952	0.041745	0.041745	100.00
218	Atlanta	13121	46953	0.034405	0.034405	100.00
219	Atlanta	13121	46954	0.031337	0.031337	100.00
220	Atlanta	13121	46955	0.029762	0.029762	100.00
221	Atlanta	13121	46956	0.115977	0.115977	100.00
222	Atlanta	13121	46957	0.115618	0.115618	100.00
223	Atlanta	13121	49951	0.062139	0.062139	100.00
224	Atlanta	13121	49952	0.021185	0.021185	100.00
225	Atlanta	13121	49953	0.050087	0.050087	100.00
226	Atlanta	13121	49954	0.129785	0.129785	100.00
227	Atlanta	13121	49955	0.059688	0.059688	100.00
228	Atlanta	13121	49956	0.113572	0.113572	100.00
229	Atlanta	13121	55011	0.064447	0.064447	100.00
[illegible]	Atlanta	13121	55012	0.053513	0.053513	100.00
[illegible]	Atlanta	13121	55013	0.087241	0.087241	100.00
232	Atlanta	13121	55014	0.138325	0.138325	100.00
233	Atlanta	13121	55015	0.115127	0.115127	100.00
234	Atlanta	13121	55021	0.344384	0.344384	100.00
235	Atlanta	13121	55022	0.297994	0.297994	100.00
236	Atlanta	13121	66011	0.276059	0.276059	100.00
237	Atlanta	13121	66012	0.099666	0.099666	100.00
238	Atlanta	13121	66013	0.117031	0.117031	100.00
239	Atlanta	13121	66014	0.065924	0.065924	100.00
240	Atlanta	13121	66015	0.180469	0.180469	100.00
241	Atlanta	13121	66021	0.085742	0.085742	100.00
242	Atlanta	13121	66022	0.153311	0.153311	100.00
243	Atlanta	13121	68011	0.265862	0.265862	100.00
244	Atlanta	13121	68021	0.291861	0.291861	100.00
247	Atlanta	13121	76019	0.760365	0.608413	80.02
248	Atlanta	13121	76021	0.189941	0.014336	7.55
252	East Point	13121	112011	0.303311	0.061611	20.31
253	East Point	13121	112012	0.298089	0.161036	54.02
261	Atlanta	13121	673	0.150356	0.150356	100.00
	Totals:			38.807602	28.079426	

For Radius of 2 Mi., Circle Area = 12.566371

Block	Total	Partial	% Within

No.	City	Group ID	Area	Area	Radius
99	Atlanta	13121 445	0.058750	0.021551	36.68
109	Atlanta	13121 525	0.238606	0.003475	1.46
111	Atlanta	13121 532	0.110627	0.055091	49.80
112	Atlanta	13121 533	0.208607	0.208607	100.00
113	Atlanta	13121 534	0.082251	0.082251	100.00
114	Atlanta	13121 535	0.293833	0.084682	28.82
115	Atlanta	13121 561	0.063077	0.063077	100.00
116	Atlanta	13121 562	0.064775	0.064775	100.00
117	Atlanta	13121 563	0.076414	0.076414	100.00
118	Atlanta	13121 564	0.074896	0.074896	100.00
119	Atlanta	13121 565	0.058004	0.057341	98.86
120	Atlanta	13121 566	0.047359	0.034449	72.74
121	Atlanta	13121 571	0.142521	0.012200	8.56
122	Atlanta	13121 572	0.063520	0.052953	83.36
123	Atlanta	13121 573	0.049530	0.049317	99.57
125	Atlanta	13121 582	0.232828	0.124216	53.35
138	Atlanta	13121 631	0.078323	0.078323	100.00
139	Atlanta	13121 632	0.081000	0.081000	100.00
140	Atlanta	13121 633	0.193138	0.193138	100.00
141	Atlanta	13121 634	0.217809	0.217809	100.00
142	Atlanta	13121 641	0.480002	0.480002	100.00
143	Atlanta	13121 651	0.423676	0.423676	100.00
144	Atlanta	13121 652	0.127225	0.127225	100.00
145	Atlanta	13121 653	0.308548	0.308548	100.00
[illegible]	Atlanta	13121 654	0.073940	0.073940	100.00
[illegible]	Atlanta	13121 655	0.083524	0.083524	100.00
148	Atlanta	13121 656	0.239297	0.169394	70.79
149	Atlanta	13121 671	0.145823	0.145823	100.00
150	Atlanta	13121 672	0.041646	0.041646	100.00
152	Atlanta	13121 674	0.051006	0.051006	100.00
153	Atlanta	13121 675	0.399513	0.399513	100.00
154	Atlanta	13121 676	0.254397	0.254397	100.00
155	Atlanta	13121 677	0.296340	0.296340	100.00
156	Atlanta	13121 691	0.326346	0.099744	30.56
157	Atlanta	13121 692	0.293064	0.293064	100.00
158	Atlanta	13121 693	0.577665	0.441083	76.36
159	Atlanta	13121 701	0.528927	0.528927	100.00
160	Atlanta	13121 702	0.323003	0.062548	19.36
161	Atlanta	13121 703	0.365966	0.360725	98.57
162	Atlanta	13121 704	0.709338	0.709338	100.00
163	Atlanta	13121 705	0.260577	0.260577	100.00
164	Atlanta	13121 706	0.775957	0.775957	100.00
165	Atlanta	13121 707	0.251641	0.251641	100.00
166	Atlanta	13121 711	0.360664	0.149568	41.47
167	Atlanta	13121 712	0.097781	0.097602	99.82
168	Atlanta	13121 713	0.539559	0.213867	39.64
174	Atlanta	13121 731	1.781444	0.371978	20.88
176	Atlanta	13121 733	0.455379	0.158793	34.87
177	Atlanta	13121 741	0.500027	0.154566	30.91
178	Atlanta	13121 742	0.370927	0.000740	0.20
179	Atlanta	13121 751	0.571966	0.571966	100.00
180	Atlanta	13121 752	0.152063	0.039963	26.28

181	Atlanta	13121 753	0.261441	0.249994	95.62
182	Atlanta	13121 754	0.151313	0.151313	100.00
183	Atlanta	13121 755	0.192521	0.037160	19.30
207	East Point	13121 1111	0.759284	0.040595	5.35
217	Atlanta	13121 46952	0.041745	0.003948	9.46
229	Atlanta	13121 55011	0.064447	0.033042	51.27
230	Atlanta	13121 55012	0.053513	0.053513	100.00
231	Atlanta	13121 55013	0.087241	0.087241	100.00
232	Atlanta	13121 55014	0.138325	0.138325	100.00
233	Atlanta	13121 55015	0.115127	0.115127	100.00
234	Atlanta	13121 55021	0.344384	0.344384	100.00
235	Atlanta	13121 55022	0.297994	0.297994	100.00
236	Atlanta	13121 66011	0.276059	0.032414	11.74
237	Atlanta	13121 66012	0.099666	0.033937	34.05
238	Atlanta	13121 66013	0.117031	0.025831	22.07
239	Atlanta	13121 66014	0.065924	0.049733	75.44
240	Atlanta	13121 66015	0.180469	0.044478	24.65
243	Atlanta	13121 68011	0.265862	0.265862	100.00
244	Atlanta	13121 68021	0.291861	0.291861	100.00
261	Atlanta	13121 673	0.150356	0.150356	100.00
	Totals:		18.557663	12.480354	

For Radius of 1 Mi., Circle Area = 3.141593

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
141	Atlanta	13121 634	0.217809	0.010835	4.97
142	Atlanta	13121 641	0.480002	0.130467	27.18
143	Atlanta	13121 651	0.423676	0.122911	29.01
149	Atlanta	13121 671	0.145823	0.145823	100.00
150	Atlanta	13121 672	0.041646	0.041646	100.00
152	Atlanta	13121 674	0.051006	0.051006	100.00
153	Atlanta	13121 675	0.399513	0.399513	100.00
154	Atlanta	13121 676	0.254397	0.214846	84.45
155	Atlanta	13121 677	0.296340	0.294088	99.24
159	Atlanta	13121 701	0.528927	0.204761	38.71
162	Atlanta	13121 704	0.709338	0.382376	53.91
164	Atlanta	13121 706	0.775957	0.164535	21.20
165	Atlanta	13121 707	0.251641	0.230558	91.62
234	Atlanta	13121 55021	0.344384	0.249684	72.50
235	Atlanta	13121 55022	0.297994	0.295381	99.12
243	Atlanta	13121 68011	0.265862	0.072077	27.11
261	Atlanta	13121 673	0.150356	0.150356	100.00
	Totals:		5.634670	3.160862	

For Radius of .5 Mi., Circle Area = 0.785398

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
149	Atlanta	13121 671	0.145823	0.024476	16.78
150	Atlanta	13121 672	0.041646	0.041646	100.00
152	Atlanta	13121 674	0.051006	0.038766	76.00
153	Atlanta	13121 675	0.399513	0.246419	61.68
154	Atlanta	13121 676	0.254397	0.026632	10.47
155	Atlanta	13121 677	0.296340	0.010717	3.62
159	Atlanta	13121 701	0.528927	0.000043	0.01
162	Atlanta	13121 704	0.709338	0.051868	7.31
165	Atlanta	13121 707	0.251641	0.040948	16.27
234	Atlanta	13121 55021	0.344384	0.021499	6.24
235	Atlanta	13121 55022	0.297994	0.132416	44.44
261	Atlanta	13121 673	0.150356	0.150356	100.00
	Totals:		3.471364	0.785787	

For Radius of .25 Mi., Circle Area = 0.196350

No.	City	Block Group ID	Total Area	Partial Area	% Within Radius
153	Atlanta	13121 675	0.399513	0.099574	24.92
235	Atlanta	13121 55022	0.297994	0.039450	13.24
261	Atlanta	13121 673	0.150356	0.057326	38.13
	Totals:		0.847863	0.196350	

================== Site Data =================

Population:	169732.39
Households:	68826.88
Drilled Wells:	11.56
Dug Wells:	0.16
Other Wells:	27.71

============= Partial (RING) data ===============

---- Within Ring: 4 Mile(s) and 3 Mile(s) ----

Population:	73686.60
Households:	31353.36
Drilled Wells:	5.38
Dug Wells:	0.16
Other Wells:	11.71

** Population On Private Wells: 13.02

---- Within Ring: 3 Mile(s) and 2 Mile(s) ----

Population:	49372.41
Households:	19456.68
Drilled Wells:	0.18
Dug Wells:	0.00
Other Wells:	0.00

** Population On Private Wells: 0.45

---- Within Ring: 2 Mile(s) and 1 Mile(s) ----

Population:	35569.70
Households:	13675.33
Drilled Wells:	6.00
Dug Wells:	0.00
Other Wells:	6.62

** Population On Private Wells: 15.61

---- Within Ring: 1 Mile(s) and .5 Mile(s) ----

Population:	8472.51
Households:	3275.23
Drilled Wells:	0.00
Dug Wells:	0.00
Other Wells:	6.27

** Population On Private Wells: 0.00

---- Within Ring: .5 Mile(s) and .25 Mile(s) ----

Population:	2020.48
Households:	825.88
Drilled Wells:	0.00
Dug Wells:	0.00
Other Wells:	2.18

** Population On Private Wells: 0.00

---- Within Ring: .25 Mile(s) and 0 Mile(s) ----

Population:	610.69
Households:	240.40
Drilled Wells:	0.00
Dug Wells:	0.00
Other Wells:	0.93

** Population On Private Wells: 0.00

** Total Population On Private Wells: 29.08

OVERSIZED

DOCUMENT

REFERENCE # [illegible]

ENDANGERED AND THREATENED SPECIES

U.S. FISH AND WILDLIFE SERVICE

REGION 4 - ATLANTA

PREFACE

The materials in this notebook are provided as an aid to anyone having a continuing need for current information on Federally listed endangered and threatened species found within Region 4 of the U.S. Fish and Wildlife Service. This area includes the Carolinas, Georgia, Florida, Alabama, Tennessee, Kentucky, Mississippi, Arkansas, Louisiana, Puerto Rico, and the Virgin Islands.

Recipients of the notebook are placed on a permanent mailing list and will automatically receive updated information whenever listing or other changes occur. Questions or comments pertaining to the notebook should be directed to the Endangered Species Office, U.S. Fish and Wildlife Service, Richard B. Russell Federal Building, 75 Spring St., S.W., Atlanta, Georgia 30303; telephone 404/221-3583 or FTS 242-3583. Other questions pertaining to endangered species matters should be addressed to one of the Service field stations listed at the end of this Preface.

The notebook is divided into two primary sections. Materials in the first section provide quick reference as to what species are listed, proposed, or under review, the states where they occur, the location of critical habitat areas, and other related information. The second part of the notebook contains species accounts which briefly discuss such things as the status, range, life history, and management needs of listed species. Please note that the range maps for these species generally reflect current distribution, but in many cases they reflect distribution rather broadly and should only be interpreted in relation to other information included in the species account.

The Endangered Species Act - General

Passage of the Endangered Species Act of 1973 gave the United States one of the most far-reaching laws ever enacted by any country to prevent the extinction of imperiled animals and plants. Under the law, the Secretary of the Interior (acting through the U.S. Fish and Wildlife Service) has broad powers to protect and conserve all forms of wildlife and plants he finds in serious jeopardy. The Secretary of Commerce, acting through the National Marine Fisheries Service, has similar authority for protecting and conserving most marine life.

Congress addressed the question of why we should save endangered species in the preamble to the Endangered Species Act, holding that endangered and threatened species of fish, wildlife and plants "are of esthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people." In making this statement, Congress was summarizing a number of convincing arguments advanced by thoughtful scientists, conservationists, and others who are greatly concerned by the disappearance of wildlife.

Protecting endangered species and restoring them to the point where their existence is no longer jeopardized is the primary objective of the U.S. Fish and Wildlife Service's Endangered Species Program.

Federally Listed Species by State

GEORGIA

(E=Endangered; T=Threatened; CH=Critical Habitat determined)

Mammals	General Distribution
Bat, gray (*Myotis grisescens*) - E	Northwest, West
Bat, Indiana (*Myotis sodalis*) - E	Extreme Northwest
Manatee, West Indian (*Trichechus manatus*) - E	Coastal waters
Panther, Florida (*Felis concolor coryi*) - E	Entire state
Whale, finback (*Balaenoptera physalus*) - E	Coastal waters
Whale, humpback (*Megaptera novaeangliae*) - E	Coastal waters
Whale, right (*Eubalaena glacialis*) - E	Coastal waters
Whale, sei (*Balaenoptera borealis*) - E	Coastal waters
Whale, sperm (*Physeter catodon*) - E	Coastal waters

Birds	
Eagle, bald (*Haliaeetus leucocephalus*) - E	Entire state
Falcon, American peregrine (*Falco peregrinus anatum*) - E	North
Falcon, Arctic peregrine (*Falco peregrinus tundrius*) - T	Coast, Northwest
Plover, piping (*Charadrius melodus*) - T	Coast
Stork, wood (*Mycteria americana*) - E	Southeastern swamps
Warbler, Bachman's (*Vermivora bachmanii*) - E	Entire state
Warbler, Kirtland's (*Dendroica kirtlandii*) - E	Coast
Woodpecker, ivory-billed (*Campephilus principalis*) - E	South, Southwest
Woodpecker, red-cockaded (*Picoides (=Dendrocopos) borealis*) - E	Entire state

Reptiles	
Alligator, American (*Alligator mississippiensis*) - T(S/A)*	Coastal plain
Snake, eastern indigo (*Drymarchon corais couperi*) - T	Southeast

*Alligators are biologically neither endangered nor threatened. For law enforcement purposes they are classified as "Threatened due to Similarity of Appearance." Alligator hunting is regulated in accordance with State law.

GEORGIA (cont'd)

	General Distribution
Turtle, Kemp's (Atlantic) ridley (Lepidochelys kempii) - E	Coastal waters
Turtle, green (Chelonia mydas) - T	Coastal waters
Turtle, hawksbill (Eretmochelys imbricata) - E	Coastal waters
Turtle, leatherback (Dermochelys coriacea) - E	Coastal waters
Turtle, loggerhead (Caretta caretta) - T	Coastal waters

Fishes

Darter, amber (Percina antesella) - E,CH	Conasauga R., Murray County
Darter, snail (Percina tanasi) - T	S. Chickamauga Cr., Catoosa
Logperch, Conasauga (Percina jenkinsi) - E,CH	Conasauga R., Murray County
Sturgeon, shortnose (Acipenser brevirostrum) - E	Coastal rivers

Plants

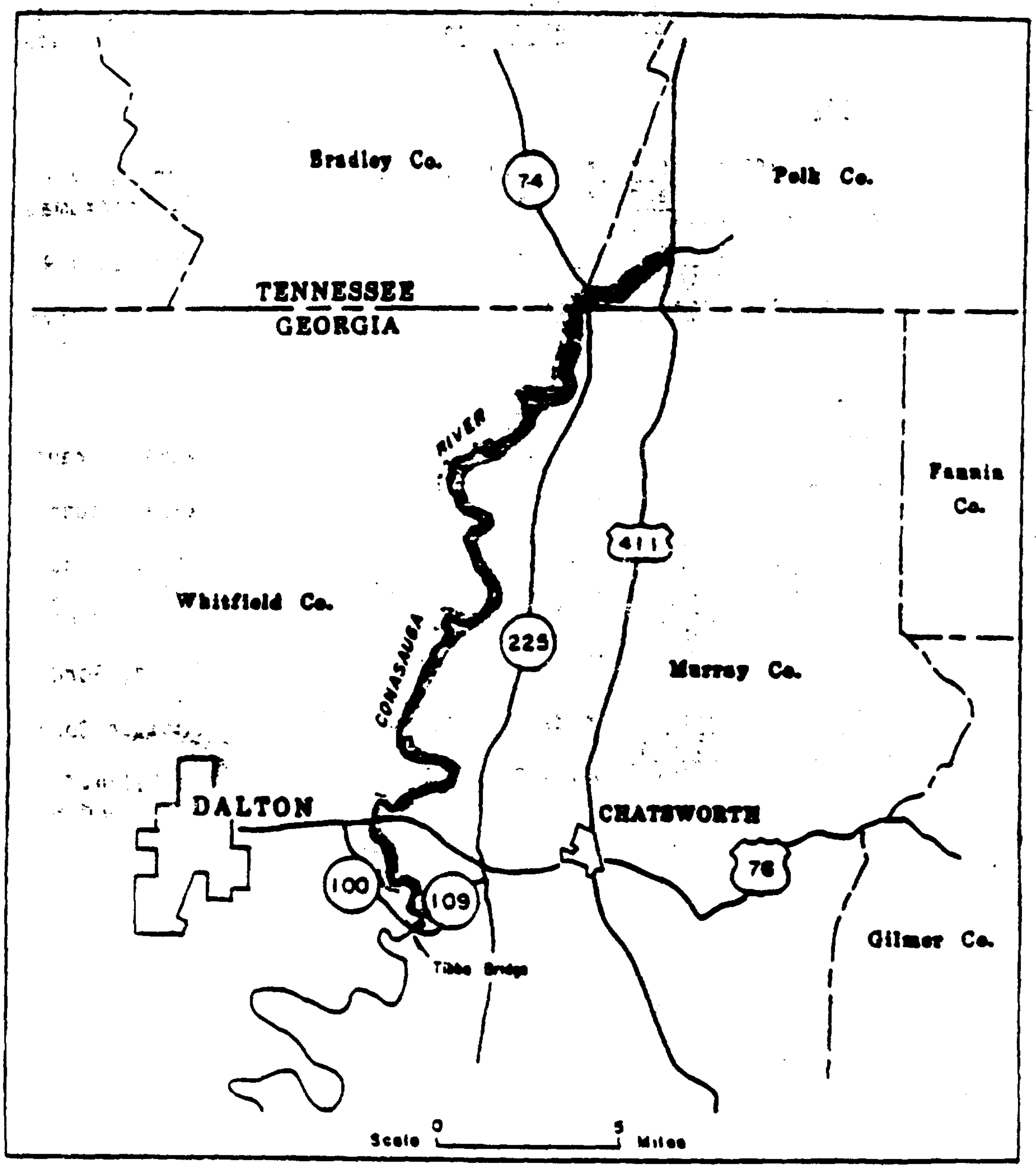
Baptisia arachnifera (hairy rattleweed) - E	Wayne, Brantley Counties
Isotria medeoloides (small whorled pogonia) - E	Rabun County
Lindera melissifolia (pondberry) - E	Wheeler County
Oxypolis canbyi (Canby's dropwort) - E	Burke, Lee, Sumter Counties
Sarracenia oreophila (green pitcher plant) - E	Towns County
Scutellaria montana (large-flowered skullcap) - E	Floyd, Gordon, Walker Counti
Torreya taxifolia (Florida torreya) - E	Decatur County
Trillium persistens (persistent trillium) - E	Tallulah-Tugaloo River syste Rabun and Habersham Countie

GEORGIA - Critical Habitat

Percina antesella, "amber darter"

Conasauga River from the U.S. Route 411 bridge in Polk County, Tennessee, downstream approximately 33.5 miles through Bradley County, Tennessee and Murray and Whitfield Counties, Georgia, to the Tibbs Bridge Road bridge (Murray County Road 109 and Whitfield County Road 100).

Constituent elements include high quality water, riffle areas (free of silt) composed of sand, gravel, and cobble which becomes vegetated primarily with *Podostemum* during the summer.

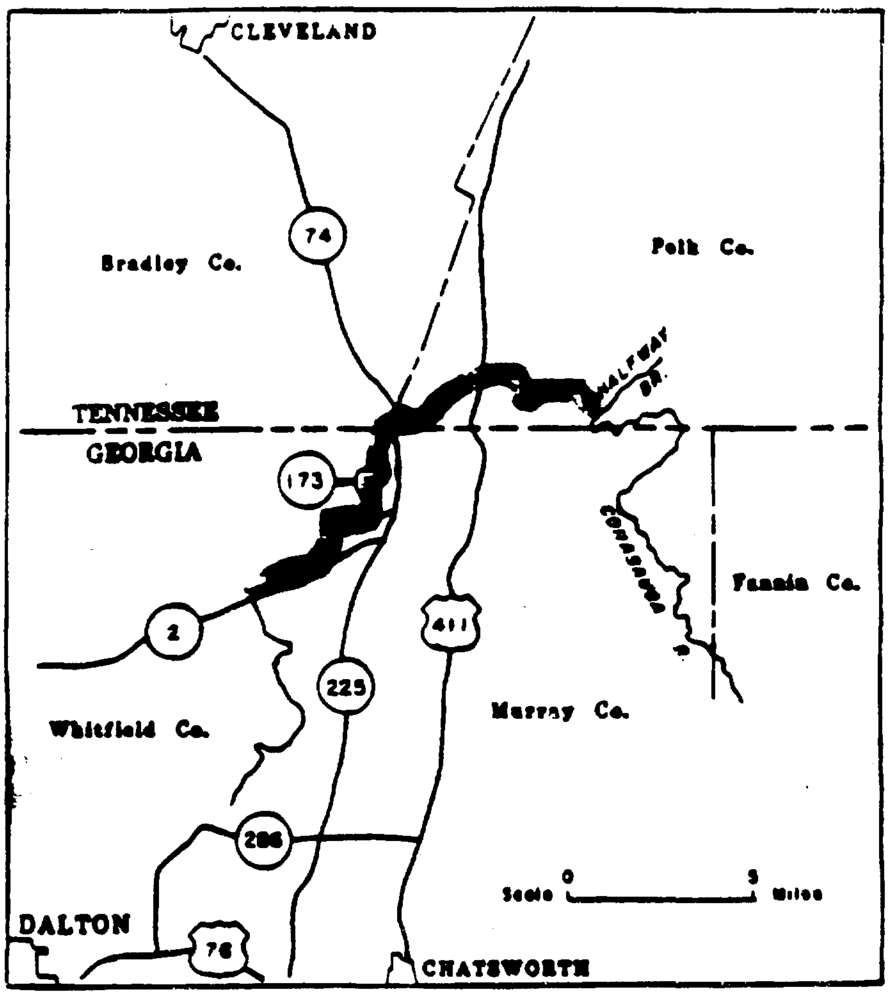


GEORGIA - Critical Habitat

Percina jenkinsi, "Conasauga logperch"

Conasauga River from the confluence of Halfway Branch with the Conasauga River in Polk County, Tennessee, downstream approximately 11 miles to the Georgia State Highway 2 bridge, Murray County, Georgia.

Constituent elements include high quality water, pool areas with flowing water and silt free riffles with gravel and rubble substrate, and fast riffle areas and deeper chutes with gravel and small rubble.



OVERSIZED

DOCUMENT

Georgia Department of Natural Resources

205 Butler Street, S.E., Suite 1252, Atlanta, Georgia 30334
Joe D. Tanner, Commissioner
Harold F. Reheis, Director
Environmental Protection Division

August 24, 1993

CERTIFIED MAIL
Return Receipt Requested

Ms. Jeanette C Gage
President
United States Plating & Bumper Service, Inc.
78 Milton Avenue, SE
Atlanta, Georgia 30315

Re: Notice Of Violation
EPA ID No. GAD984282301

Dear Ms Gage:

This letter is to inform US Plating that on August 16, 1993 the Georgia Environmental Protection Division (EPD) Hazardous Waste Management Branch conducted a site investigation of the US Plating Burn Site. This site reconnaissance was conducted to make a determination on whether further remedial/removal activity is warranted pursuant to the July 31, 1992 fire at US Plating.

During the investigation four 55-gallon rusty, leaking and unlabeled drums were found on-site. The leakage was tested with pH paper and showed a pH of 13. Another unlabeled drum was found on-site. This drum was constructed of stainless steel and had Ashland Chemical Co. printed on the lid. A pH paper analysis of the contents of the drum indicated a pH of 0.0. This is a violation of 40 CFR Part 262 Subpart C and Part 265 Subpart I.

US Plating must conduct a waste determination on the contents of the drums pursuant to 40 CFR Part 261 and properly dispose of the wastes. Enclosed is a list of commercial hazardous waste treatment and storage facilities that may be able to aid US Plating in the disposal of the waste.

Within twelve (12) days of receipt of this letter US Plating must have properly disposed of the waste. If no action is taken on the part of US Plating further enforcement action may be pursued. If you have any questions contact Ken Grall at (404) 656-2833.

Sincerely,

Susan Eason

Susan Eason
Acting Unit Coordinator

File: US Plating (B)

Georgia Department of Natural Resources

205 Butler Street, S.E., Suite 1252, Atlanta, Georgia 30334
Joe D. Tanner, Commissioner
Harold F. Reheis, Director
Environmental Protection Division

PARTIAL LISTING OF COMMERCIAL HAZARDOUS WASTE TREATMENT/STORAGE FIRMS DOING BUSINESS IN GEORGIA (FOR INFORMATIONAL PURPOSES ONLY)

* Alternate Energy Resources, Inc.
2730 Walden Drive
Augusta, Georgia 30904
706/738-1571

* Arivec Chemicals, Inc.
67962 Huey Road
Douglasville, Georgia 30133
404/942-1550

Ashland Chemical Company
400 Telfair Road
Savannah, Georgia 31401
613/889-4670
404/934-0902

Ashland Chemical Company
4550 Northeast Expressway
Doraville, Georgia 30244
404/448-7010

* Chemical Conservation of Georgia, Inc.
1612 James Rogers Circle
Valdosta, Georgia 31601
407/859-4441

Ensco Environmental Services
1015 South Harris Street
Dalton, Georgia 30720
706/226-6477

* M & J Solvents Company, Inc.
1577 Marietta Road, NW
Atlanta, Geogia 30318
404/355-8240

MKC Enterprises, Inc.
5856 New Peachtree Road
Doraville, Georgia 30340
404/457-1341

MCF Systems Atlanta, Inc.
5353 Snapfinger Woods Drive
Decatur, Georgia 30035
404/593-9434

OHM Resource Recovery Corp.
5371 Cook Road
Morrow, Georgia 30260
404/361-6181

PPM Inc. (Handles PCB's only)
1875 Forge Street
Tucker, Georgia 30084
404/934-0902

Safety-Kleen Corporation
4800 S. Old Peachtree Road
Norcross, Georgia 30071
404/662-5151

Safety-Kleen Corporation
5920 Coca Cola Blvd.
Columbus, Georgia 31909
706/561-0107

Safety-Kleen Corporation
Southlake Commercial Park
Commercial Drive
Morrow, Georgia 30260
404/960-1275

Safety-Kleen Corporation
6580 Hawkinsville
Macon, Georgia 31206
912/788-9398

Safety-Kleen Corporation
5217 Augusta Road
Garden City, Georgia 31418
912/964-7040